

FAMILY RESPONSE TO COMPUTERIZED COGNITIVE
RETRAINING WITH BRAIN INJURED INDIVIDUALS

A DISSERTATION
SUBMITTED TO THE GRADUATE EDUCATIONAL POLICIES COUNCIL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

by

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FAMILY RESPONSE TO COMPUTERIZED COGNITIVE RETRAINING
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ABSTRACT: Computerized cognitive retraining is a technique for remediation of the cognitive and behavioral changes which follow a traumatic brain injury. The technique utilizes specifically developed computer software which builds on the basic foundations of intellectual functioning. While the injured patient is the target of treatment, the method appeared to have an impact on the patient's family as well. Families of patients who participated in computerized cognitive retraining initially appeared to have fewer difficulties with anxiety, depression, and family problems. They also appeared to be more involved in the patient's treatment than were similar families who had not had this experience.

The experiment evaluated the secondary psychological effects of computerized cognitive retraining on the brain injured patient's primary caretaker in the family. The dependent variables studied were perception of family involvement in patient treatment, anxiety, depression and perception of family problems.

Subjects were recruited from the outpatient case load of the Psychology Department of Fort Sanders Regional Medical Center in Knoxville, Tennessee and from a local support group for families of patients who have

experienced a traumatic brain injury. The injured patients and family members participated in the retraining technique. A total of seventeen patient/family member pairs participated in the study.

Subjects participated in either the experimental or control treatments. The experimental group underwent five sessions of approximately one hour in length. The patient and family member worked together during the course of the retraining. Brief counseling followed each session. The treatment group used an Atari 800 computer and Bracy's "Foundations" cognitive retraining software package (Psychological Software Services, Indianapolis, Indiana). The control group was a waiting list, minimum contact group, whose participation was limited to completion of the pre and posttest materials.

Family members in both groups completed pre and posttesting packages. These included: a demographic questionnaire, the "Problem Solving Inventory" (Heppner, 1982a, 1982b), the "State/Trait Anxiety Inventory" (Spielberger, 1983), the "Beck Depression Inventory" (Beck, 1961), and the "Scale of Marriage Problems" (Swenson & Fiore, 1982).

The experiment utilized Kerlinger's pretest-posttest control group design (Kerlinger, 1973). Patient/family pairs were randomly selected from the available subject pool. Control or experimental treatment groupings were assigned by stratified random sampling. Data were analyzed by the use of two way analysis of variance with repeated measures on one factor. Throughout the analysis, a level of $p < .05$ was required to infer statistical significance.

The results of this experiment did not support the effectiveness of

computerized cognitive retraining as a specific intervention method for the families of brain injured individuals. The findings revealed that there were no statistically significant differences between the control and treatment groups on measures of perception of family involvement, depression, or perception of family problems. The treatment group experienced a statistically significant increase in state anxiety following the experimental treatment. The validity, generalizability and implications for these findings were discussed in light of prior research.

Recommendations for further research in the area of family response to computerized cognitive retraining include replication of the study with greater numbers of subjects and more sophisticated evaluation and treatment methodology. It is also suggested that future research address the patient's cognitive level, the utilization of varied retraining protocols specific to the patient's level of function, and premorbid psychosocial factors which may influence the process of cognitive remediation.

For my wife and son,
Linda Hurley Pendergrass
Mark Justin Pendergrass

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"If quantitative precision is demanded, it is gained, in the current state of things, only by so reducing the scope of what is analyzed that most of the important problems remain external to the analysis."

Dr. John Steinbruner, Harvard School of Business

(1974). The Cybernetic Theory of Decision: New Dimensions of Political Analysis.
Princeton, N. J. : Princeton University Press. p. 328.

I. INTRODUCTION

Computerized cognitive retraining is a new method for remediation of the cognitive and behavioral changes which follow a traumatic brain injury. The technique utilizes specifically developed software which builds on the basic foundations of intellectual functioning. Frequently, the training is initiated while the patient is hospitalized in a rehabilitation setting and is then continued on a daily basis when the patient is discharged to his or her home. The training may also be initiated on an outpatient basis. This may supplement existing outpatient rehabilitation services such as speech therapy, physical therapy, occupational therapy or psychotherapy. Regardless of the format, cognitive retraining requires the support and assistance of the family. While the injured patient is the primary beneficiary of the treatment, the method appears to have an impact on the family as well.

Informal observation of families of brain injured patients who participate in cognitive retraining seems to suggest that these families experience less adaptive difficulties than do families who are not involved in such a program. They appear to have fewer difficulties with reactive anxiety and depression. Self-confidence and self control appear to be enhanced. The families are more capable of dealing with the problems of managing both themselves and their brain injured family member. These families also appear to have a greater

awareness of the patient's strengths and limitations.

Research suggests that the most disruptive problems for a patient's family concern the patient's difficulties with memory, problem solving, and behavior. In response to the patient's deficits, families may display symptoms of anxiety and depression, have helpless and hopeless feelings toward their situation, and have increased somatic complaints. The family may become increasingly ineffective in dealing with problem solving situations.

Prior studies have focused strictly on the patient's response to computerized cognitive retraining. It is important to study the behavioral changes that the family experiences.

Cognitive Disruption

Neurological injury results in a variety of cognitive and behavioral impairments which debilitate both the patient and the family. Most commonly, this is seen as a loss of general intelligence and ability. The patient has difficulty in dealing with information and information processing. Losses may be highly specific, such as a disruption of motoric control or generalized to higher level executive and integrative functions. Bracy (1982) noted that disruption of language abilities, memory, visuospatial perception, attending, and organizational capability frequently accompanies a brain injury. Such deficits are rarely isolated. More commonly, deficits form a complex interaction of cognitive and behavioral problems.

Injuries to the left brain cause damage to the speech control centers. This

may include disruption of language and memory. The patient's ability to receive communication and express him or herself may be impaired. Memory is frequently disrupted. Shorty term memory is especially fragile. The patient may be unable to recall even simple one step commands immediately after they are given. Learning potential is impaired due to dependence on verbal processing and loss of memory (Richardson, 1982; Jones, 1981).

Right brain processes are involved with perception, integration, and synthesis of visuospatial information. Injuries to the right hemisphere disrupt problem solving, sequencing, planning and organization of motoric and cognitive tasks. This has a profound effect on the patient's ability to complete abstract, conceptual, and problem solving tasks (Lezak, 1983).

Individuals with traumatic brain injuries may not have overt behavioral symptoms. Deficits may be presented as subtle changes in thought processing, emotion, and cognitive ability.

Neuropsychological correlates. Low level neuropsychological deficits are correlated with increased independence in brain injured patients. Levin, Grossman, Rose, and Teasdale (1979) reported that post injury predictors for adequate recovery after a brain injury included an essentially normal I.Q., minimal problems with behavioral control, and an absence of aphasic symptoms.

Brooks, Aughton, Bond, Jones, and Rizui (1980) noted that brain injuries at the moderate level resulted in significant cognitive disruption. Patients in their study demonstrated significant losses of verbal I.Q., decreased ability to copy

geometric forms, and speech processing difficulties. Consistent low scores on measures of learning and memory were also demonstrated.

Heaton and Pendelton (1981) dealt with more specific criterion measures to predict loss of cognitive and functional abilities. The authors noted that I.Q. was an accurate predictor, and full scale scores of less than ninety suggested in marked difficulties in post-traumatic adjustment.

Gilchrist and Wilkinson (1979) reported similar findings and noted that as cognitive and emotional impairment increased, long term functionality decreased. Functionality was defined to include the ability to engage in self care activities, socially appropriate interactions, and work at some level. In their study, approximately sixty-two percent of patients with mild to moderate injuries were able to return to work in limited roles. In patient groups where severe disability was present, less than twenty-four percent of the patients were able to return to even the most sheltered forms of work. Patients with such disabilities frequently had difficulty in completing even simple self-care activities.

Research suggests that cognitive disruption has a major impact on the functional level of the brain injured patient. General measures of I.Q., problem solving, and learning may be used to suggest the severity of cognitive disruption. The intellectual components of such tests note that brain injured individuals suffer losses in a variety of areas that are critical to daily functioning. Losses in memory, learning ability, attention deficits, difficulties in problem solving and lack of mental flexibility are problematic areas. These deficits become even more

debilitating when they are paired with the behavioral changes that frequently accompany a brain injury.

Behavioral Deficits

Personality and behavioral changes may cause greater difficulties for the brain injured individual, and their families, than do cognitive losses. These difficulties may include anxiety, depression, and autistic behaviors. Aggression is present in many patients. Social isolation and emotional withdrawal are also reported (Jones, 1981). Lezak (1978) reported that victims frequently have poor motivation for self-care, vocational and/or social activities. Such patients are often described by those around them as making no sense, confused, or as acting crazy. The patient's residual cognitive abilities may be minimally impaired, but combinations of apathy, poor judgement, inability to organize, and poor frustration tolerance make many of these patients difficult to manage and essentially unemployable (Brooks and Aughton, 1979).

Levin and Grossman (1978) reported the observation of consistent behavioral symptoms in brain injury patients. These problems included agitation, physical and emotional withdrawal, and motoric retardation. Depression, sensitivity to stress and increased anxiety have also been reported (Levin, Grossman, Rose & Teasdale, 1979). In extreme cases, post-traumatic behaviors may mimic a schizophrenic process (Bond, 1975).

Debilitating effects. Cognitive deficits may be compounded by behavioral disruption. Miller (1980) reported that the majority of patients with a clinically

significant head injury failed to attain their premorbid level of function in social and occupational areas. He attributed this to problems with emotional control, memory, and learning.

Levin and Grossman (1978) studied the behavioral presentation of brain injured patients. The patients in the study had injuries which were classified as moderate to severe. Patients with a moderate injury displayed excessive anxiety, depression, emotional withdrawal, behavioral disorganization, and motor slowing. Patients with severe injuries consistently presented distractability, gross emotional withdrawal, poor behavioral control, and little insight to the extent of their disabilities. When the patients were evaluated by the use of the "Brief Psychiatric Rating Scale", the moderate and severe injury groups were distinct.

McKinlay, Brooks, Bond, Martingale and Marshall (1981) used family reports to categorize the behavioral problems which followed a brain injury. Family "progress reports" were evaluated at three, six, and twelve month intervals. A significant number of families reported psychosocial problems with the injured individual. Memory loss, slowness, irritability, anxiety, psychosomatic preoccupation, lability and depression were reported by the majority of the families. The study further suggested that many of the behavioral problems increased, rather than decreased, over time.

Social and occupational changes. The cognitive and behavioral changes which brain injury patients experience are pervasive and effect all areas of individual and familial functioning. This is apparent in the situations of the

patient's families. Some patients attempt to become socially active or return to work. These attempts are often unsuccessful.

Bond (1976) studied the social and vocational pursuits of a group of severely injured patients. Families in Bond's study reported that the patient's personality changes memory problems were the most frequent cause of familial and social difficulty. As difficulties increased, socialization attempts by the patient decreased. Bond further noted that as the patient's behavioral symptoms increased, the capacity to return to any form of work proportionally decreased.

Levin, Grossman, Rose, and Teasdale (1979) also studied the socialization patterns of severely injured patients. Their findings were similar to Bond's. The authors reported the patients had difficulties in monitoring and following social interactions. When difficulties were experienced, socially inappropriate responses increased. The authors attributed this to the patient's frustration and poor behavioral control. The injured groups tended to withdraw from social interactions when past experiences were negative. In a significant number of cases, behavioral disruption escalated to a point where psychiatric hospitalization was necessary.

Oddy and Humphrey (1980) studied the long term social response of family, friends and employers to a group of young adults with severe brain injuries. They reported that both employers and families seemed to tolerate the patients rather than encourage reintegration into a work or family role. Problems were reported in social situations where personality and memory changes were most evident.

Oddy and Humphrey attributed these difficulties to personality changes which were demonstrated as memory deficits, dependence, anxiety, depression and paranoid misinterpretation of social interactions. Even families and employers who were initially supportive had difficulty maintaining their attitudes. A significant number reported increased problems at the one year follow up.

It is easy to see the difficulties which families face in attempting to care for a brain injured individual. Behavioral symptomology may be severe enough to require psychiatric hospitalization. More frequently, such patients are managed in the home or through outpatient mental health and medical services. Family coping is strained in an attempt to deal with such behavioral problems. Lezak (1983) aptly described the family response to such difficulties. She stated that ". . . a person who has sustained a moderate to severe brain injury is at best a nuisance at home, at worst, a terror" (pp. 170).

Summary of Cognitive and Behavioral Disabilities

In summary, the patient who experiences a traumatic brain injury faces difficulties in many areas of his or her life. Cognitive disruption is present. This may include expressive and receptive speech loss, difficulty with memory, planning, organization, and an inability to attend to even simple tasks. Brain injuries may also involve the behavioral control centers of the brain. Restlessness, agitation, apathy, uncooperativeness, lack of insight, or depression can result from such an injury. In extreme cases, organic psychosis

may result. Any of these symptoms can be debilitating, but in combination, as is frequently the case with traumatic injuries, the results are often catastrophic.

Several studies described the psychosocial outcomes of moderate to severe injuries. Few victims are able to return to work or school and function at levels comparable to their premorbid levels. This is attributed to cognitive losses and behavioral problems. A major disabling factor appears to be the interaction of impaired memory, personality change, and physical disability. The patient finds work and leisure pursuits physically inaccessible and is unable to compete in the workplace due to behavioral and cognitive disruption. Memory of prior functioning can contribute to anxiety and depression as the patient realizes the extent of their disabilities. The patient who has little or no insight into their problems may be even more difficult to deal with. Frustration with the activities of daily living often results. Anger is often directed toward those around the patient. These outbursts may be threatening and accuatory.

Family cohesion and function is strained as they attempt to deal with the problems of living with, and caring for a brain injured individual. Research suggests that families are more able to cope with physical disability than with the personality changes the patient undergoes. Behavioral changes, especially those involving memory and personality, appear to be the major threat to family stability (Bond, 1975; Brooks & Aughton, 1979; Lezak, 1983; McKinlay, Brooks, Bond, Martingale, & Marshall, 1981).

FAMILY RESPONSE TO TRAUMATIC BRAIN INJURY

The literature suggests families experience a variety of problems in their attempts to adapt to living with an individual who is characterologically and cognitively different because of a brain injury. Lezak (1978) suggested that all close family members are affected by such an accident. Normal interactions are altered and the family experiences increased tension, anxiety, and depression which may be expressed as mood disturbance and/or feelings of helplessness and hoplessness. These are intensified when the family's perception of the patient's problems are unrealistic and false hopes for recovery exist. The situation is further compounded when no physical symptoms of disability are obvious (Bond, 1975).

As was suggested, family members develop symptoms of stress related adjustment reactions. Several authors convincingly argue that no family member is immune to this phenomena. The children of brain injured parents, develop adaptive problems which may include academic and behavioral difficulties or delinquency. Anxiety, uncertainty, and depression may play a role in the development of these difficulties. These children also tend to leave home much earlier than do other groups. This appears to be a function of active or passive parental abandonment and lack of significant interaction with parents or other family members (Lezak, 1978). While the children develop many adaptive symptoms, McKinlay et al. (1981) suggested that parents and spouses of brain damaged patients are prone to develop more severe adjustment reactions.

Spouses and parents become isolated and withdrawn as a result of their situation. Major changes in socialization patterns and contacts with friends and relatives take place. Families also engage in fewer recreational activities after the accident. This seems to be related to the adaptive difficulties spouses and parents go through. Unresolved grief about the child or spouse's injury also contributes to the withdrawal and decreased socialization. The grief process that accompanies a neurological injury is similar to that seen in death, but the parent or spouse cannot or will not proceed through the process of grief resolution (Lezak, 1978).

Cognitive and behavioral regression of the patient may be encouraged by the responses of the close family members (Rosenbaum & Najenson, 1976; Stern & Najenson, 1976). Excessive involvement, intrusion, and over-protection may serve to alienate spouses and debilitate patients. While in-laws and/or parents feel that they are protecting and helping the patient and their spouse, they may be interfering with family adaption processes. Possessiveness, jealousy, and hostility frequently result and family coping mechanisms are further strained.

Parents and spouses present a variety of psychological symptoms in response to the injury of a loved one. These may include depression, anxiety disorders, and psychosomatic illnesses. Mauss-Clumm and Ryan (1981) reported that wives of brain injured men had clinically significant levels of depression and anxiety as a result of their husband's injuries. These wives also

reported markedly increased frustration, irritability, and anger toward their spouses and children. These findings were consistent with Lezak's reports that spouses experienced isolation, anxiety attacks, obsessive rumination, sleep and eating disorders, depression and a significant occurrence of physical illness (Lezak, 1978).

Rosenbaum and Najenson (1976) reported that wives of brain injured soldiers had markedly higher levels of depression than did the wives of those who experienced a disabling spinal cord injury. As depression increased, social and familial interaction decreased and the wives reported greater marital difficulties. Depression, without other physical and psychological problems, has been correlated with increased marital dysfunction (Coleman & Miller, 1975). When the effects of depression are paired with the other difficulties experienced by families of the brain injured, family stability is greatly threatened.

Data obtained from research on familial response to cerebral vascular accident victims adds insight into the difficulties which families of traumatically injured patients experience. While the causation of the injury is different, cognitive and behavioral outcomes can be strikingly similar. Strokes can result in significant changes in verbal processing, learning, memory, and cognitive organizational abilities. Behavioral changes are also seen. These may include poor motivation, agitation, confusion, lability of mood, depression and anxiety. These problems are consistently reported by the families of patients who have experienced a traumatic injury.

Aroskar and Dittmar (1978) studied the problems which stroke victim's families reported. They found that the most distressing factor of the patient's condition was the mood change which followed the stroke. The presence of mood change was correlated with increased levels of anxiety and depression in the members of the family. Families also reported an inability to maintain "adequate" relationships. The authors noted that these difficulties persisted over time and social isolation increased with time.

McCormick and Williams (1979) studied the responses of wives who cared for their husbands after they, the husbands, experienced a stroke. The patients had cognitive and behavioral changes similar to those seen in injury victims. Their research suggested that the wives felt that others did not understand their situation and the difficulties of the life style changes that were required of them. The most frequent descriptors used by the wives to describe their situation were "... living on the edge of sanity," and the fear of "... going crazy" (pp. 1411).

The findings of McCormick and Williams (1979) were consistent with other studies on family response to brain injuries. Stroker (1983) found that physical and mental disabilities contributed to conflict in a previously stable relationship. Family reports suggested high levels of role confusion, ambiguity, and difficulties in coping with the stressors of living with a stroke victim. Symptomatically, the families reported an increase in overt anger, hostility, and anxiety. These responses were attributed to guilt over family responses to the patient's behaviors. The study also suggested that the physical disability contributed to

adaptive difficulties, but this was of less concern than were the changes attributed to personality variation.

Bardach's (1969) findings were consistent with those of Stroker (1983) and other researchers. Bardach surveyed wives of injury victims and found that they felt responsible and guilty about the behavior of their husbands. The wives described themselves as frustrated, lonely, guilty, and impatient.

Summary of family dynamics. The literature suggests that families experience a variety of problems in their attempts to adapt to living with an individual who has experienced a traumatic brain injury. Lezak (1978) reported that all close family members are affected. This may present as increased tension and anxiety, depression, and feelings of helplessness and hopelessness. This may be intensified by false hopes of recovery and unrealistic expectations on the part of the family. The problem appears to be compounded when the patient has no overt physical symptoms of disability. Bond et al. (1975) noted that deficits of learning, memory, and emotional lability were more difficult for family members to accept than were physical disabilities.

Researchers of family dynamics have identified major trends that develop in such families. These affect both spouses and dependent children differently. Rosenbaum and Najenson (1976) reported that spouses of brain injured soldiers developed symptoms within a year of the time of the injury. These included increased anxiety, significant depression and social withdrawal. Lezak supported these findings and stated that spouses also had difficulty with isolation,

anxiety attacks, physical symptoms, and sleep and eating disorders. Children of the patients are also affected but appear to be more resistant than are parents or spouses (McKinlay et al., 1981). They may display academic, behavioral, and/or delinquency problems. These children leave home earlier than other groups of children. Parental abandonment, frustration, and lack of interaction with either parent appear to be the caustiaon (Lezak, 1978).

Stroker (1983) noted that the family plays a vital role in the rehabilitation of the patient. Without the support and assistance of the family, the patient has little chance for reintegration into the family or community.

Families must learn that anger and grief are natural reactions to a traumatic brain injury. This is seen in both the patient and their families. Role changes are a normal part of the family adaption to the injured individual. These role changes are very stressful and may contribute to the overall dysfunction of the family.

Family Involvement in Rehabilitation

Rehabilitation research and theory support the inclusion of the family in the rehabilitation process. Families who have a sense of involvement show greater social and emotional adjustment to the difficulties they must confront. Involved families tend to feel, and actually be, less isolated. Fewer symptoms of anxiety and related disorders are reported. Family participation provides an opportunity for them to learn about the problems they must face. It also provides an opportunity for the family to develop coping strategies. Decision making can be encouraged and the family can be supported and reassured about their ability to

adapt. It appears that inclusion of the family into the cognitive rehabilitation of the brain damaged patient may have similar effects. Family participation in all components of rehabilitation is an essential factor. Diller and Gordon (1981) noted that rehabilitation is an interactive process where the patient, family, and rehabilitation professionals work together to facilitate the acquisition of skills necessary to both the patient and the family. This supposition is well supported in the literature.

In an early study of response to organized rehabilitation efforts, Anderson (1964) suggested the importance of including the family. The author noted that those families who were involved in the educational and psychological treatment of brain injured family members demonstrated better general adaptation than did the families who were nonparticipants.

Versluys (1984) reported that rehabilitation potential is poor if families are not adequately prepared for and integrated into the patient's rehabilitation program. Families experience feelings of helplessness and hopelessness which are equal to or greater than those experienced by the patients. As a result, rehabilitation gains may be lost or minimized when a family becomes dysfunctional. This is attributed to the physical and emotional demands of caring for and living with a brain injured person. By using the information and problem solving skills gained from cognitive retraining, the family may adapt their interactions and minimize attitudes and behaviors which contribute to family or patient disability. Jaffee (1978) noted that inclusion of the family in the process of

treatment acted to minimize symptoms of all involved. Adaptive skills of the family were reported to increase.

If families do not receive adequate psychological intervention, individual and family problems persist. The problems may also show an increase in severity after the patient's discharge from rehabilitation services. Belcher (1978) studied a number of families involved in neurological rehabilitation programs where cognitive and family interventions were minimized. Families in the study reported they felt that their psychosocial needs had been ignored by these programs. Adaptive difficulties of both the patients and their families increased after the discharge from rehabilitation services. All families who were interviewed stated that they felt counseling and educational treatments were necessary components of a rehabilitation program.

Rorher, Adelman, Puckett, Tomey, Talbert and Johnson (1980) used a group educational model to deal with the adaptive problems families faced after the neurological injury of a family member. Realistic education, adaptive skills and sharing of relevant experiences were stressed in the groups. Families who participated in the treatment demonstrated greater involvement with the patients, less isolation, and lower levels of anxiety than did families in the control group. The treatment group families also saw themselves as being able to cope adequately with their situation.

D'Afflitti and Weitz (1974) found that family groups with stroke patients increased involvement and enhanced the social and emotional adjustment of

patients and family members. They found group participation tended to increase communication within the family. Realistic expectations were more common in the involved families. The families also demonstrated increased ability to deal with emotional conflicts.

Watzlawick and Coyne (1980) reported that problematic responses of family members may be modified by interventions which increase understanding and interpersonal control. The cognitive and behavioral data provided by feedback from computerized cognitive retraining is consistent with the information requirements suggested by the authors. This information aids the family in understanding the limitations of the patient's problem solving and information processing abilities. Behavioral responses to frustration, boredom, and denial may also be observed. The family, in conjunction with the psychologist, can use this information to develop coping strategies to deal with both the patient's responses and their response to the patient's behaviors. The sense of helplessness and hopelessness is decreased as intervention becomes feasible. Reactions of anxiety, depression and disorganization may then be minimized.

Dr. Robert Sbordone, a leader in the field of neuropsychology and cognitive rehabilitation, reported the necessity of integrating the family into rehabilitation efforts. Sbordone noted that families have difficulty understanding the changes that accompany a brain injury. This is most obvious in areas of subtle cognitive and behavioral change. Sbordone feels that the therapist must use available data to help family members develop realistic expectations for the patient and

themselves. If families expect more, or less, than the patient is capable of, their behavior may be inconsistent and unrealistic. This may result in frustration for all involved and potentiate psychological dysfunction (Sbordone, 1984).

Cognitive Rehabilitation with Microcomputers

Cognitive rehabilitation involves a variety of treatment methods which are designed to remediate deficits which follow brain injuries. Training techniques focus on redeveloping the functions of memory, conceptualization, problem solving, and perception. These skills are the basic components of higher level intellectual processing and are essential if the patient is to return to any level of independent functioning. Previously, it was felt that such cognitive losses were irreparable and little, beyond behavioral control methods or psychotropic medications, could be offered to such patients and their families. A number of authors have reported successful retraining treatments where the quality of both the patient and family's lives has improved. The authors attribute these improvements to extensive cognitive retraining (Diller, 1976; Gianutsos, 1980; Miller, 1980).

Encouraged by development of computer application in education and special education, rehabilitation specialists developed and restructured many cognitive retraining tasks for microcomputer application. The microcomputer offers distinct advantages for cognitive retraining.

Microcomputers are within a price range that many families can afford. Insurance companies may also assist in purchasing systems which are

specifically prescribed for cognitive retraining. Programs may be presented and monitored on a daily basis with the family serving as adjunct therapists.

Cognitive retraining requires multiple presentations of the stimulus materials.

Computers are proficient at such tasks. they have endless patience and do not become frustrated, angry, or discouraged. The computer offers immediate feedback on the patient's performance. The novelty of the computer and retraining programs may be stimulating and help counteract the attention deficits and low arousal levels which are seen in brain injured patients. Further, all tasks can be programmed to the individual performance level of the patient. Scoring protocols are developed as components of the software or may be easily written into the programs. This allows tracking of progress on individual tasks (Kurlychek and Glang, 1984).

Bracy (1982), Perez, Brown, Cooke, Pickett, Rivera, and Grabois (1980), and others have developed specific programs for cognitive retraining and neuropsychological evaluation using microcomputers. Lynch (1981) categorized the learning and neuropsychological components of many available computer games which are appropriate for retraining tasks. The "games as therapy" retraining method has been successfully applied in several rehabilitation programs.

Homebased computerized cognitive retraining. The patient's family, working in conjunction with the rehabilitation psychologist may establish a reasonably priced, effective program for home based cognitive retraining. This

requires the purchase or rental of a microcomputer. The psychologist then prescribes the software with appropriate tasks for the patient's performance level. These may involve simple responses to visual or auditory stimuli, differential responding, discrimination, visuospatial perception, organization and/or memory tasks. At higher levels, concept formation, complex memory, problem solving, visual tracking and fine motor control may be addressed.

After the patient's needs are assessed, the psychologist assists the family in developing a treatment plan and work schedule. Specific tasks are prescribed and performance recording methods are established. The family may then assist the patient in the daily cognitive retraining program. Such a program allows the patient to work on cognitive retraining tasks without the hands-on supervision of a psychologist. The psychologist monitors the patient's progress, modifies retraining tasks as necessary, and helps the patient and family develop strategies for dealing with problems. Patients undergoing home based cognitive retraining program are seen on a weekly, every two week, or monthly schedule. Expense to the family is minimized in this manner. Training benefits may be obtained without daily sessions with the psychologist.

Response data provided in the course of computerized cognitive retraining gives the family accurate information about the patient's performance abilities. It adds information about the response to frustration, confusion, and anxiety. This information can assist the family in developing skills to deal with such responses when they are generalized. Counseling is also an active component of

computerized cognitive retraining. The data obtained from behavioral responses provides an excellent source for the therapist. Specific behavioral examples are readily available and the psychologist can assist the family and patient in developing interventions.

RESEARCH QUESTIONS AND STATEMENT OF HYPOTHESES

Computerized cognitive retraining provides families and patients with an interactive treatment that appears to have an impact on both the family and the patient. The patient benefits by redeveloping cognitive skills which were lost due to their injury. The family becomes actively involved in retraining and rehabilitation efforts. They appear to undergo emotional and behavioral changes which tend to reduce the psychopathology of the family system.

Computerized cognitive retraining provides a medium to help the family see and understand subtle deficits which result from neurological injury. In practice, it is difficult for the family to understand attending, discrimination, and response differentiation. These skills are essential to normal functioning. Activities of daily living offer few opportunities for patients to consistently use these skills. Retraining tasks focus on these areas and the family may compare the patient's responses to the norms for uninjured individuals. Computer analysis of performance on the retraining tasks provides a measurement of cognitive and behavioral gains. The family is able to see improvement in specific cognitive areas. Without such information, families may not be aware of the subtle changes that are taking place.

As was previously noted, computerized cognitive retraining is in its early stage of development. The method appears to have an impact on the family as well as the patient. Families who are participating in active cognitive retraining programs seem less anxious and depressed, have a greater sense of control of their problems and themselves, and are more aware of the patient's limitations and strengths than are families who are not involved in similar programs. Prior studies have focused on the patient's response to computerized retraining, dealing with only learning and skill acquisition. It is important to study behavioral changes that the family may experience. Research on family response to this method is at the discovery level at this time. If effects are noted, they may then be compared to other forms of intervention.

Research Questions

The following research questions were proposed.

1. Does the use of computerized cognitive retraining influence the family members' perceptions of their involvement in the process of rehabilitation?
2. Does participation in computerized cognitive retraining have any effect on the level of depression of the family member who is working with the brain injured patient?
3. Does participation in computerized cognitive retraining have any effect on the level of anxiety of the family member who is working with the brain injured patient?
4. Does computerized cognitive retraining influence the family member's

confidence and ability to deal with family problems which result from living with a brain injured individual?

Statement of Hypotheses

Based on the research questions, the following hypotheses were proposed for the study:

1. The family members participating in computerized cognitive retraining will report significantly greater levels of involvement than will family members who are in the control treatment group.

2 A. The family members participating in computerized cognitive retraining will report significantly less depression than will family members who are in the control group.

2 B. The family members participating in computerized retraining will report significantly less hopelessness than will family members who are in the control group.

3. The family members who are involved in computerized cognitive retraining will experience and report significantly less anxiety than will family members who are in the control group.

4. Family members who are participating in computerized cognitive retraining programs with the brain injured patients will report significantly fewer family problems than will family members who are in the control group.

II. RESEARCH METHOD

Description of the Study

The experiment was designed to evaluate the effect of computerized cognitive retraining on the family of the brain injured patient. The family member participating in the experiment was defined to be the parent or spouse who functioned as the patient's primary caretaker. Little, if any, previous work has focused on the effects of a retraining technique on the adaptations and behaviors of the family. Prior studies focused on the patient's response to computerized cognitive retraining and have dealt with only learning and skill acquisition.

The research design chosen was the pretest-posttest control group design. This design allowed adequate statistical inference and controlled several possibly confounding variables. Data was evaluated with a two way analysis of variance with repeated measures on one factor. The two factors were the grouping factor, or treatment versus control, and a time factor, or the pre and posttest scores. The most important feature of the analysis was the evaluation of the interaction between the factors.

Research Design

The experimental design was based on before and after control group design. This technique is also called the pretest-posttest control design (Kerlinger, 1973). Both Campbell and Stanley (1963), and Kerlinger (1973) note

that this design is a true experimental design due to randomization of treatment and comparison of the treatment group to a control group.

Internal Validity

As with any design and analysis, confounding variables exist. The pretest-posttest control group design provides control for rival hypotheses which influence both internal and external validity. Events which influence group history and maturation are controlled by several procedures. General historical events which might influence subject response should occur randomly and influence both the experimental and control groups equally. Intrasession events were controlled by random implementation of the experimental treatment and the control treatment. The pre and posttesting of the control group took place simultaneously with the testing and treatment of the experimental group. Further control was added by the use of a single researcher. This reinforced group to group consistency of procedure and expectations. Confounding events which would have been present with multiple researchers were minimized.

Maturation and group regression were significant threats to internal validity. Maturation and instrumentation effects should be equally present in both groups. This was further controlled by random selection of the available subjects and random assignment of subjects to either the experimental or control conditions. Standardized instruments were used for evaluation of the dependent variables. Group differences could not be attributed to novel testing effects or to observer bias.

Group regression was controlled by random assignment of the subjects available from the same extreme subject pool. Families which have brain injured individuals in their households are extreme by definition. Any regression effects should be equally present in both the experimental and the control groups.

Group selectivity, or groups which may have influenced the dependent variables by some inherent trait, presented a threat. This was controlled by random selection and stratified randomization of the subjects by demographic variables. These included variables such as participation of spouse vs. child, length of time since injury, participation in rehabilitation programs, sex of participant, and age of the subject. Stratification was utilized in an attempt to insure the initial equality of the groups on the dependent variables.

External Validity

Pretest-posttest designs may produce a marked test sensitization effect. This effect would be present in both groups if, in fact, it did occur. Cronbach and Furby (1970) suggest sensitization is of limited concern in treatment research. They noted that the pretest is, in effect, a component of the treatment process. This was the case in this experiment. To minimize this effect, no unusual or unorthodox testing procedures were used. Instruments were standardized and were administered as described in the literature.

A constant level of expectation of outcome between the control and treatment groups was maintained by the use of a waiting list control group rather than a placebo or secondary treatment group. The no contact, or waiting list

group, avoided any inadvertent treatment effects which could be caused by a placebo treatment. While a placebo is therapeutically inert by definition, therapist interaction and inadvertent training may become an active component when placebos are utilized. Katkin and Goldband (1979) noted that valid placebo treatments are difficult to construct and frequently contaminate research results by becoming active treatments. Substantial treatment effects were necessary to contribute to the variance between groups. This was especially true with the small number of subjects utilized in this study.

Generalizability was limited to a demographically similar group which underwent similarly controlled treatment. It was essential to delimit the results of the outcomes with care. Results were delimited by the group parameters established in the "Limitations" subsection.

Statistical Analysis

Data was analyzed by the use of "SPSS-X" (1983) and "BMD-08V" (1971) statistical packages. The SPSS program was utilized for the demographic data and treatment data was evaluated with the BMD subprogram for the analysis of variance with repeated measures. Homogeneity of the control and treatment groups were also evaluated for an overall estimate of the external validity of the study. Grouping factors, demographics, and variance between the control and treatment groups were used to evaluate the "between subjects" effects of the treatment. Throughout the analysis, a level of $p < .05$ was required to infer statistical significance.

Data was analyzed by the use of a two way analysis of variance with repeated measures on one factor. The two way ANOVA with repeated measures allowed three specific statistical questions to be answered. If the row main effect was significant, then grouping affected the dependent variables. The second factor, the time effect, evaluated changes across time independent of the grouping factor. Changes on this factor might be influenced by subject history, maturation or test sensitization. The key effect would be a significant interaction of the main effects; this interaction suggests differences in the two groups across the pretest and posttest measures. If this effect was present, inspection of the means or post hoc tests would reveal the results of the experiment, noting whether the treatment was related to changes across time.

This design and analysis is well suited for the study of group changes which can be attributed to treatment effects. The two way ANOVA with repeated measures on one factor allows analysis of the treatment effects, time factors, or any interaction which contributes to group variance. This analysis also allows the groups to be measured for homogeneity on the dependent variables. This was evaluated prior to implementing the treatment (Ferguson, 1981; Huck, Cormier, & Bounds, 1974).

Subjects

Subjects for the experiment were recruited from two sources. Volunteers came from a local support group for the families of head injury victims and from the outpatient caseload of the Psychology Department of the Patricia Neal

Rehabilitation Program, Fort Sanders Regional Medical Center in Knoxville, Tennessee. These families are involved in the daily management of an individual who has experienced a traumatic brain injury. The families are in the position to be most effected by the patient's cognitive and behavioral deficits.

A total of twenty subjects were recruited for the study. The group was randomly selected from the available subject pool. Subjects for the experiment were selected from the available subject pool and were then randomly assigned to either the treatment or control conditions. Each group consisted of ten patient/family member dyads.

Limitations

Inclusion in the study was limited to families who live with a victim of a traumatic brain injury. Residual cognitive and behavioral deficits were present in all of the patients included in the study. These included the previously defined outcomes of traumatic brain injury. Patient's were evaluated by the use of the "Rancho Los Amigos Scale of Cognitive Functioning" to note propriety of inclusion in the study groups. The Rancho Scale is a behaviorally defined scale which lists characteristics of cognitive and language disruption in a hierarchal manner.

Patients functioning at a Rancho level of five were included in the study. Patients at this level are alert and able to respond to simple commands consistently. Behavioral disorganization may be observed in novel or complex situations. Agitation may be present, but this is generally reactive to

environmental or inter-personal stimuli. Distractability, confusion, confabulation, and amotivation are frequently seen. Memory is impaired.

The highest level utilized was the Ranchos level seven. This is the automatic appropriate level of functioning. Automatic behavioral routines may be performed but recall and understanding are impaired. Judgement, planning, and problem solving are also impaired in such patients. These patients frequently require supervision in novel situations to insure their safety. Few disruptive behaviors are seen (Hagen, no publication date available).

Hardware

The hardware included an Atari 800 home microcomputer with a single Percom Data disc drive. This included the Atari "BASIC" cartridge. A Spectravison directional joystick was used for selection and manipulation of the stimulus materials. Video display was presented on an Amdek Color I monitor.

Software

The cognitive retraining software was developed by Bracy and is distributed by Psychological Software Services of Indianapolis, Indiana. The study used the "Foundations" skill package.

The "Foundations" package is a set of programmed learning tasks designed to rebuild attention, discrimination, response initiation and suppression, and response differentiation. The programs utilize audio and visual stimuli. Immediate feedback is provided for responses throughout the programs. A statistical compilation is provided at the completion of each game. This includes

mean response time, variance, correlation, error rate, and the correlation of stimulus delay to response time (Bracy, 1982).

Program Development. In his early work with patients who had experienced brain injuries from strokes or accidents, Bracy attempted to develop computer programs for the evaluation and diagnosis of cognitive dysfunction. His interest evolved to the area of cognitive rehabilitation and the development of methods and techniques for rebuilding and/or reorganizing cognitive processes. Bracy found that it was necessary to make the injured brain work on basic cognitive tasks to reinforce the inherent process of cognitive recovery and re-organization. Cognitive rehabilitation efforts require frequent stimulation and multiple repetition of stimulus materials if they are to be successful. Further, learning tasks need to be presented in a consistent and controlled manner. Bracy felt that simple computers could do these tasks efficiently. The utility of using computers for educational and remedial tasks was well documented in the education and special education literature. The need for a simple and reliable system for patient rehabilitation led to the development of the "Foundations" software system. This system met many of the needs of both therapists and patients.

Theoretical Development. The basic programs were developed from a key concept of rehabilitation psychology. Remediation of cognition is based on redevelopment of interrupted elements of cognition which are essential to intellectual processing. These elements are the components of higher level

cognitive processes. This suggests that cognitive development, much like physical development, takes place in well ordered developmental steps. It is necessary to teach the patients components and subskills of intellectual processing which they can then apply to higher level processing. Full neurological function infers the ability to interact with the environment in complex situations. This requires the ability to perceive, plan, make decisions, and act according to the results of situational analysis. If subcomponents of this process, such as attending, discrimination, and differential responding are not intact, higher level skills cannot be achieved. The learning process, as well as a mastery learning focus, is evident throughout the packages. The "Foundations" programs target the development and re-integration of these basic skills (Bracy, 1982; 1984).

The process of home based computerized cognitive retraining is cost effective. A patient engaged in a daily cognitive retraining program with a psychologist will spend in excess of eighty-four hundred dollars over a six month period. Cognitive retraining may be continued for as long as twenty-four months. A comparable program, involving a home based computer system, with weekly visits to the therapist during the first month, and visits every other week for the remaining five months, costs approximately fifteen hundred dollars. This includes the necessary hardware, software, and therapist visits. There is no available data to suggest that either method provides greater effectiveness.

Program Description

Bracy's software provides skill training that allows the brain injured individual to redevelop interrupted components of the learning process. The patient must learn how to learn if they are to benefit from cognitive retraining. These programs are designed to sequentially establish skills such as attending, concentration, and the ability to shift between various forms of simple stimuli. As the patient becomes proficient at the basic skills, they may then learn higher components such as discrimination, differential response, visual scanning and the initiation/inhibition of responses. Learning by mastery is utilized. It is necessary for the patient to establish the necessary cognitive building blocks before they can advance to more complex learning tasks.

The "Foundations" program teach the skills that Bracy defines as the building blocks of cognitive development. The "Foundations" package includes the following programs: Simple Visual Reaction I, Simple Visual Reaction II, Visual Reaction Stimulus Discrimination I, Visual Reaction Stimulus Discrimination II, Visual Reaction Differential Response I, Visual Reaction Differential Response II, Visual Reaction Auditory Prestimulus, Visual Discrimination Differential Response I, Visual Discrimination Differential Response II, Visual Scanning, Simple Auditory Reaction, Auditory Reaction Stimulus Discrimination, and Auditory Reaction Visual Prestimulus.

The patient must be able to attend and concentrate on a simple task. This is provided by the "Simple Visual Reaction" program. The patient must respond by

pushing the joystick button each time he or she sees a yellow square on the monitor screen. A similar program, "Simple Auditory Reaction", trains the patient to respond to an auditory stimulus. When the patient is able to respond reliably to the tasks, he or she may then progress to the visual and auditory stimulus discrimination programs.

The discrimination programs require the patient to respond to a target stimuli while inhibiting his/her response to a different competing stimuli. The visual discrimination programs present either a yellow or a blue square in a random order. The patient is to respond to the yellow square, while inhibiting a response to the blue square. Similarly, the auditory discrimination program presents varying tones that must be matched to a target tone. These programs require attending and concentration, as well as discrimination between two similar stimuli.

In the discrimination-differential response programs, "Visual Discrimination Differential Response I & II", the patient must make a differential response based on the differences between two visual stimuli. This involves matching the stimulus color and responding with either the right hand or left hand. These programs utilize the previously noted skills and add response choices based on the characteristics of the stimulus presented by the computer.

The "Foundations" program package also uses a prestimulus series where the patient must inhibit responses to familiar stimuli while responding to a novel target stimulus. The "Visual Reaction, Auditory Prestimulus" program presents

the patient with a tone prior to the visual target. The "Auditory Reaction, Visual Prestimulus" program presents a visual distractor prior to the auditory target. These programs require all of the previously noted skills as well as response inhibition.

Bracy feels that these are the basic skills required for the patient to interact effectively with their environment. These skills are also the sub-components of higher intellectual functions. The patient must be able to deal with an ever changing volume of information. This requires the ability to deal with novel stimuli and accurately perceive this information. Responses are based on perception and require planning and decision making based on feedback and analysis of the available information. Learning and attending are necessary skills.

Computer training cannot provide all the necessary components for such learning to take place. This requires the empathy, guidance, and structure of therapist interaction. The computer can provide a consistent training instrument for developing the core skills necessary for such learning to take place. It presents learning tasks in a reliable and consistent manner. It also provides feedback on responses, times the involved events, records responses, and provides statistical information on the quality of the responses.

Bracy's programs are widely used in cognitive rehabilitation due to their adaptability to the deficits seen in moderate to severe brain injuries. They help develop skills of attention, attention shifting, differential responding,

discrimination, and initiation or inhibition of responses. These are the basic skills essential to the patient who has impairment of learning due to an injury. They provide the "foundations" for further learning. Several authors such as Sbordone, Gianutsos, Perez and others provide remediation software, but the skill level exceeds the capabilities of many head injury victims. These programs deal with high level skills such as complex problem solving, reading, complex visual searching, and the monitoring of multiple stimuli. Bracy reports that it is important to establish responses to the basic skills prior to attempting higher level training (Bracy, 1984).

Procedure

After selection, each patient and family member was scheduled for a total of five treatment sessions. The pretest package of instruments was administered during the first session. The sessions were scheduled for one hour, two times weekly. Total treatment time for the experimental and control group was approximately five hours.

Experimental Group

The experimental treatment with computerized cognitive retraining was presented as described in Bracy's guidelines. Bracy notes that the initial order of presentation is extremely important. If developmental sequencing is not followed, essential components may be overlooked. All patients are started on the simple reaction programs, "Simple Visual Reaction I, and Simple Auditory Reaction". Performance targets are reaction times of 0.4 seconds or less and a variances of

less than 100.0. These programs are usually repeated at least twice, with each hand, during the early training sessions. When these criteria are consistently achieved, the patient is then progressed to the discrimination series programs: "Visual Reaction, Stimulus Discrimination and Auditory Reaction Stimulus Discrimination". As cognitive complexity of the programs increases, reaction times also tend to increase. The general response targets are reaction times of less than 0.5 seconds and a variance of less than 100.0. Practice is continued on the specific programs until this level is consistently reached. These criterion are used throughout the "Foundations" series. When these goals are met, the patient is then progressed through the remaining programs in the order presented on the program menu (Bracy, 1982).

For the purposes of this experiment, it was necessary to progress in a manner that was more rigid than that described by Bracy. Less emphasis was placed on the exact performance levels that were described. It was desired that the patients and their family members be exposed to the full range of the "Foundations" series. It was necessary for participants to attempt programs that involved attending, discrimination, response initiation and suppression, and differential responding. Volunteer subjects cannot be expected to dedicate an unlimited or unspecified amount of time to an experimental trial. Time restrictions negated exact compliance with the performance criteria. It was felt that the exposure to the cognitive material and the interaction effects of the training were the crucial components of the experiment. All tasks were presented in the order

described.

Treatment sessions followed these guidelines:

Session one. The patient and family were familiarized with the general goals of the training program and introduced to the computer. The family was encouraged to act as a coach to the patient and provide support and encouragement. The family was also instructed in the record keeping technique. They then kept the patient's performance record. The general goal for the sessions was to obtain a response time of less than 0.4 seconds with a variance of less than 100.0.

The following programs were presented in the first session: "Simple Visual Reaction I and Simple Auditory Reaction". Each program was run for two trials to the right and left hand. If the patient's performance was near the target level, "Simple Visual Reaction II" was added as a final trial.

The initial programs are designed to help build attention to a cognitive task. On "Simple Visual Reaction I" the subject reacts by pushing the joystick button as soon as a yellow square is seen on the monitor. The "Simple Auditory Reaction" program requires a similar response to a computer generated tone. Feedback appropriate to the response of the patient is provided throughout the "Foundations" programs.

The remainder of the session focused on counseling with emphasis on impulsivity, concentration, and attending. Specific references to observed behaviors were used. Plans for upcoming sessions were discussed.

Session two. This session was similar to session one. The family was instructed in the loading of the programs and selection from the menu. They were then responsible for the operation of the computer. The patient completed "Simple Visual Reaction" and "Simple Auditory Reaction" programs with one trial per hand. Two new programs were added to the patient's work load. The first was "Visual Reaction Stimulus Discrimination". The patient completed two trials with each hand. The second program, "Auditory Reaction, Stimulus Discrimination", was presented in similar fashion. The family continued to record data and support and encourage the patient.

The discrimination series programs require attending to task as well as the ability to interpret differences in stimuli characteristics. The programs require that the patient inhibit responses to the nontarget tones or squares. On the "Visual Reaction Stimulus Discrimination" program, the subject should react to a yellow square while inhibiting the response to a blue square. Similarly the "Auditory Reaction Stimulus Discrimination" program requires the subject to react to a target tone and inhibit responses to other competing tones.

The computer retraining sessions was followed by a brief counseling session as outlined in session one.

Session three. This session began with a review of computer operations. The family member loaded the programs and aided the patient in the retraining session. Input from the therapist was minimal and was limited to technical direction and behavioral shaping of the family's responses to the patient. This

included encouraging the family to verbally reinforce the patient's appropriate responses, aiding the family in developing strategies to increase the patient's attending to task, helping the family to help the patients develop self-correction skills and generally assisting the family in becoming more involved in the retraining process.

In this session, the first program was a single bilateral trial with "Simple Visual Reaction II". This was followed by a similar trial with "Simple Auditory Reaction". The patient then completed two trials to each hand with "Visual Reaction Stimulus Discrimination". The session was ended with a counseling session as previously described.

Session four. The family member acted as the primary retraining therapist. The researcher was present for support and assistance. During this session, two new programs were added to the menu. The progression of the session was as follows: one bilateral trial on "Simple Visual Reaction I", a bilateral trial on "Auditory Reaction, Visual Prestimulus", a bilateral trial on "Simple Auditory Reaction" and finally a bilateral trial on "Visual Reaction, Auditory Prestimulus". Counseling followed the retraining session.

The prestimulus program series builds on prior skill training. They also add the complexity of presenting a distractor task to the cognitive task. This series requires attending, shifting of attention, and discrimination. They also require that the patient initiate the proper response to the target stimuli while inhibiting a response to familiar distractor.

In the "Visual Reaction, Auditory Prestimulus" program, the patient must depress the joystick button when the yellow square is seen. This is complicated by the presentation of a tone prior to the visual target. "Auditory Reaction, Visual Prestimulus" is similar, but the auditory target is preceeded by a visual distractor. These programs are difficult because both the target and the prestimulus have previously been used as response targets.

Session five. The final session utilized the family member as the retraining therapist. This session reviewed the most complex programs utilized in the course of the treatment. The programs were presented in a single bilateral trial. This included the following programs, presented in this order: "Visual Reaction Auditory Prestimulus, Visual Reaction Stimulus Discrimination, Auditory Reaction Visual Prestimulus, and Auditory Reaction Stimulus Discrimination". Family counseling was completed as previously described, but focused on closure of the project. Data from the sessions was evaluated at this time. The family was referred to the appropriate psychologist if they desired follow-up and continuation of the cognitive retraining program. The decision to do so was the family's. Recommendations were based on the behavioral presentation of the patient throughout the sessions and performance on the retraining tasks. Posttest forms were filled out by the family member at the completion of the final session.

Control Group

The study used a waiting list, minimum contact treatment for the control group. Subjects were placed in the control treatment condition by random

selection from the available subject pool. A total of ten subjects, defined as a patient/family member pair, were assigned to this condition. An initial contact was arranged on a random schedule. These took place while the experimental group was under treatment. This added control for the maturation factors.

During the initial contact, the subjects received a brief description of computerized cognitive retraining. The subjects also received an explanation of participation expectations for the patient and family member. Time expectations were clarified. At the end of the session, the subjects were informed that they would be contacted to arrange follow-up appointments. These were scheduled on a time schedule that was similar to the time required for the experimental group. The follow-up took place approximately three weeks after the initial contact and posttest materials were administered at that time.

During the follow-up interview, a computerized retraining evaluation was offered and scheduled if the family so desired. The retraining was presented as described in the Experimental Group Section. Data obtained in follow-up sessions with the control group was not utilized in the experiment.

Dependent Measures

The instruments selected to measure the dependent variables were chosen due to their psychometric qualities, their specificity in assessing the targeted attitudinal or behavioral areas and due to their usage in similar research efforts. All instruments have adequate reliability and validity.

The first hypothesis, measure of perception of family involvement, was

measured by use of the "Problem Solving Inventory" (Heppner, 1982a; 1982b). The scale is a self-rating scale which focuses on the person's perceptions of their problem solving behaviors and attitudes. The PSI may be filled out by the subject in a brief period. The scale consists of 35 descriptor statements which are rated on a six point rating scale. This ranges from strongly agree (1) to strongly disagree (6). Scores are factored to include estimates of problem solving confidence, approach-avoidance styles, personal control, and total problem solving scores.

The PSI was used to measure the family perception of involvement in the rehabilitation of the patient. It was hypothesized that greater involvement could be inferred by families which show greater problem solving confidence, had lower scores on the measures of avoidant styles of dealing with problematic situations, and higher scores on measures of perception of intra-personal control.

Reliability of this instrument was established by use of Cronbach's alpha coefficients. Adequate reliability was demonstrated and values are as follows: total inventory ($\alpha = .90$), problem solving confidence ($\alpha = .85$), approach-avoidance style ($\alpha = .84$), and personal control ($\alpha = .72$). In subsequent clinical trials, test-retest reliabilities were established. These were as follows: total inventory ($r = .89$), problem solving confidence ($r = .84$), approach-avoidance style ($r = .88$), and personal control ($r = .83$). Construct and concurrent validity of the scale were demonstrated by correlation of the scale with multiple simple self-rating scales, the "Means-End Problem Solving Procedure"

(Platt and Spivak, 1975), the "Rotter I-E Scale" (Rotter, 1978), and the "Meyers-Briggs Type Indicator" (Meyers, 1962). Construct and concurrent validity were consistently demonstrated (Hepner, 1982a; 1982b).

Families of patients with brain injuries frequently show greater levels of depression than do other families. The second dependent variable was measured by the use of the "Beck Depression Inventory", forms H and D. Form H measures the perception of helplessness/hoplessness while form D estimates the overall level of depression. Both forms are straightforward and involve direct behavioral and affective questions.

The "Beck Depression Inventory", (BDI), was designed to qualify and quantify affective and physiological symptoms of depression. The test is a 21 item self-report inventory which rates expressions of depression on a 0 to 3 point scale. The 0 value suggests the absence of the stated symptom while the 3 suggests severe symptomology. Scores are added to obtain a total score ranging from 0 to 63. Normative values are provided to rate levels of depression. Shaw, Vallis and McCabe (1985) report that the BDI is the most frequently used scale for rating the severity of depression.

Validity and reliability for the BDI have been extensively reported in the literature. Split-half reliability coefficients ranged from .58 to .93, and item-total correlations ranged from .22 to .86 with an average of .68. Test-retest reliability ranged from .69 to .90 in spite of the symptom fluctuation which may accompany depressive episodes.

Concurrent validity was estimated by comparing clinician's ratings of depression to the BDI total scores. The total scores were also correlated with other well established depression inventories. Clinicians ratings of depression correlated with the BDI total scores in the range of .62 to .77. Correlations between the BDI and the "Hamilton Rating Scale for Depression", the "Zung Self-Rating Depression Scale", The MMPI D-scale, and the "Depression Adjective Check List" have been reported to be high (Shaw, Vallis & McCabe, 1985).

The "Beck Hopelessness Inventory" was designed to measure perceived levels of hopelessness. Hopelessness is a significant component of depression and a variety of other psychopathological conditions. Elevated levels of hopelessness may also have an adverse effect on an individual's prognosis.

The twenty item, true-false questionnaire presents statements which are optimistic or pessimistic. Agreement with pessimistic statements and disagreement with optimistic statements suggests a hopeless outlook. Items were developed from two sources. Nine of the items were adapted from a test focusing on future attitudes. The test used a semantic differential format. The remainder of the items were selected from clinician's evaluations of the negative statements from psychiatric patients who appeared hopeless.

Scoring is completed by use of a true-false scoring key. Each statement is assigned a 0 or 1 value and scores are added to give a total score. Total scores may range from 0 to 20.

Reliability coefficients of up to .93 have been reported in the literature. The authors report item-total correlation coefficients ranging from .39 to .76.

Concurrent validity was evaluated by comparing the scale to other measures of hopelessness and negative attitudes. The scale was also compared to clinical ratings of hopelessness. The scale correlated with the Stuart "Future Test" at .60 and with the pessimism items of the BDI at .63. The correlation of the Beck HS with clinicians ratings ranged from .74 with hospitalized depressives to .62 with hospitalized psychiatric patients who had attempted suicide. Interrater reliability for the study was .86 (Beck, Weissman, Lester & Trexler, 1974).

The third hypothesis, dealing with the dependent variable of anxiety, was evaluated by the use of Spielberger's "State/Trait Anxiety Inventory". The "STAI" forms assess the level of the subject's anxiety on a trait and reactive, or state level. Prior research suggests that families of the target population have consistently elevated levels of anxiety. Living with and managing a brain injured individual is a chronic stressor and functions to raise the family's overall reactivity to anxiety. Further, research suggests that these difficulties tend to increase over time rather than stabilize.

While the trait anxiety of the family was of interest, the main interest was in the effect of the treatment on state anxiety. State anxiety is unstable over time, but is sensitive to the person by situation interaction.

It was hypothesized that the experimental treatment would aid in reducing state anxiety by altering the family's perception of their situation. The "STAI" was

selected due to its psychometric qualities and its brevity. Reliability for the "STAI" was calculated by use of Cronbach's alpha coefficients and ranged from .83 to .92. This suggests adequate internal consistency. Further, construct validity of the scale has been repeatedly demonstrated. Validity has been reported in studies with subjects under normal stress, abnormal stress, and relaxation conditions. The "STAI" consistently discriminates among these conditions (Speilberger, Gorsuch, & Lushene, 1970). The "STAI" has proved to be one of the most efficient and accurate instruments for the evaluation of the impact of brief treatments (Anastasi, 1968).

The final dependent variable, level of familial adaptive difficulties, was measured by Swenson and Fiore's "Scale of Marriage Problems" (Swenson & Fiore, 1982). This scale was designed to assess a family's ability to identify and deal with a variety of stressors which influence the quality of the familial relationship. The scale identifies six factors which may have a major impact on the family. These include problem solving, which subsumes decision making and goal setting, home labor, impact of relatives on the central family, personal care, money management, and the effect of relations with those external to the family. The scale has well established norms for families which are defined as "severely troubled", as well as for families of varying ages and length of relationship.

Psychometric qualities are acceptable. Estimates of reliability, as computed by use of Cronbach's alpha coefficients range from .82 to .92. The

reliability of the "Scale of Marriage Problems" total score is .85. Subscale reliabilities are as follows; problem solving, subscale 1 ($\alpha = .82$), child-rearing, subscale 2 ($\alpha = .78$), relatives, subscale 3 ($\alpha = .70$), personal care, subscale 4 ($\alpha = .32$), money, subscale 5 ($\alpha = .73$), and affection, subscale 6 ($\alpha = .48$), (Swenson & Fiore, 1982).

The "Scale of Marriage Problems" is sensitive to many of the difficulties that families of the target population experience. It was hypothesized that the experimental treatment will reduce the perception of family problems. This is an effect of being actively involved in the rehabilitation process and in attempts at cognitive rehabilitation. A decrease in the perception of general family problems should provide an increase in the available energy to deal with the difficulties of caring for the patient.

III. RESULTS

Overview

The purpose of this study was to evaluate the psychological effects of computerized cognitive retraining on families who participated in this form of treatment. Computerized cognitive retraining is a method which attempts to remediate cognitive deficits which result from brain injury. While the brain injured patient is the primary target of treatment, the method appeared to have an effect on the patient's family members as well.

This study evaluated the secondary psychological effects of computerized cognitive retraining on the patient's primary caretaker in the family. The dependent variables were depression, hopelessness, anxiety, perception of family involvement, and perception of family problems.

Subjects

Subjects were recruited from a local support group for the families of patient's who had suffered traumatic brain injury and from the outpatient caseload of the Psychology Department, Patricia A. Neal Rehabilitation Center, Fort Sanders Regional Medical Center in Knoxville, Tennessee. The Patricia A. Neal Center is a comprehensive rehabilitation center which provides both inpatient and outpatient services to many neurologically injured patients. A total of 20 patient/family member pairs were recruited for the study. From this group, a

total of 17 pairs completed the study.

Subjects participated in either the experimental or control treatments. The experimental group underwent five, one hour, sessions of computerized cognitive retraining. The family member worked closely with the patient during treatment. The control group was maintained on a waiting list.

Family members in each group completed pre and posttest packages which included the following instruments: a demographic questionnaire, the "Problem Solving Inventory" (Heppner, 1982a, 1982b), the "State/Trait Anxiety Inventory" (Spielberger, 1983), the "Beck Depression Inventory, forms H and D" (Beck, 1961), and the "Scale of Marriage Problems" (Swensen & Fiore, 1982).

Design and Data Analysis

The study utilized a pretest-posttest control group design. Patient/family pairs were randomly selected from the available subject pool. Control or experimental status was established by stratified random sampling. This technique was utilized to insure the initial equality of the groups.

Data were analyzed by the use of two-way analysis of variance with repeated measures on one factor. The time factor, which yielded the treatment effect, was the repeated measure. Throughout the analysis, an alpha level of $p < .05$ was required to infer statistical significance. Data were analyzed with "SPSS-X" (1983) and "BMD-08V" (1971) statistical packages.

Treatment Hypotheses

It was hypothesized that:

1. Family members participating in computerized cognitive retraining would demonstrate increased perception of involvement in treatment.
- 2A. Family members participating in the treatment group would demonstrate lowered levels of depression as measured by the Beck Depression Inventory, form D.
- B. Family members participating in the treatment group would demonstrate lowered levels of hopelessness as measured by the Beck Depression Inventory, form H.
3. Family members involved in computerized cognitive retraining would experience and report a reduction in self-perceived anxiety as measured by the STAI.
4. Family members in the treatment group would report lowered levels of familial problems at post treatment.

Demographic Variables

Demographic variables for the groups of patients and family members were evaluated by a variety of techniques to assure the initial equality of the control and treatment groups. As was noted, a sample was obtained by random sampling of a volunteer population of appropriate patients. Stratified random sampling was utilized to obtain treatment and control groups which were representative of the overall treatment population. The initial group was randomly selected from the available subject pool and demographic variables were established. Stratification variables of patient age, sex, type of injury,

educational level, prior rehabilitation treatment, and prior cognitive retraining were identified. The subjects were randomly assigned to the control or treatment conditions depending on these variables. When this was achieved, subjects were then assigned to either control or treatment conditions. The original sample consisted of a total of twenty patient/family member pairs. Due to attrition, the sample dropped to a total of eight subjects in the treatment group and a total of nine subjects in the control group. Both subjects in the treatment group withdrew due to medical problems and subsequent hospitalization. The subject in the control group withdrew at the request of the family. Although the patient and family initially agreed to participate in the study, they were hesitant to complete the psychological instruments. The family also felt that they would be unable to participate due to the time requirements.

Patient Group

In this experiment, the patient groups were passive participants in the study. Family members became the active focus of treatment. The family members were targeted for measurement of treatment effects. Selected demographic information was obtained from both patients and family members who participated in the study. Variables regarding the patient's injuries and previous treatment were noted.

In the patient treatment group, the subject's age ranged from 5 years to 52 years with a mean age of 31.6 years and a standard deviation of 14.6 years. The patient control group was similar with an age range of 13 years to 52 years with a

mean age of 26.8 years and a standard deviation of 12.1 years. Within the patient treatment group, 87.5% of the subjects were male while 12.5% were female. In the patient control group, 77.8% of the subjects were male and the remaining 22.2% of the subjects were female.

Marital status of the patient groups included the categories of single, divorced, married, widowed, and separated. The patient control group contained 55.6% single patients and 44.4% married patients. There were no patients in this group who fell within the other categories. The patient treatment group had a total of 37.5% married patients, 12.5% divorced patients and 50.0% married patients. There were no widowed or separated patients represented.

The patient group's educational level included training at the high school, technical school, college, and graduate school levels. An "other" category was included to encompass elementary, junior high school or other early education programs. Of the control group, 44.4% were high school graduates, 11.1% were technical school graduates, 33.3% completed college and 11.1% were involved in the "other" category at the time of their injury. In the treatment group, 50.0% were high school graduates, 25.0% were college graduates, and 12.5% had completed graduate education programs. Table 1 contains the means, standard deviations and percentages of the patient demographic variables.

TABLE 1

Demographic Variables: Patient Groups					
	Control Group: n=9		Treatment Group: n=8		
Continuous Variables	Mean	S.D.	Mean	S.D.	
Patient Age	26.8	12.1	31.6	14.6	
Categorical Variables					
Sex	% Group		% Group		
Male	77.8		87.5		
Female	22.2		12.5		
Marital Status	% Group		% Group		
Single	55.6		37.5		
Divorced	0.0		12.5		
Married	44.4		50.0		
Widowed	0.0		0.0		
Separated	0.0		0.0		
Education Level	% Group		% Group		
High School	44.4		50.0		
Tech School	11.1		0.0		
College	33.3		25.0		
Graduate	0.0		12.5		
Other	11.1		12.5		

Variables related to the patient's injuries.

Several variables associated with the patient's injuries and subsequent rehabilitation were felt to have potential for producing skewed groups. These factors included the accident or brain injury type, length of time since the injury, participation in organized inpatient or outpatient rehabilitation programs, and treatment in other forms of cognitive retraining. The patient's level of cognitive functioning was evaluated by his or her score on the "Rancho Los Amigos Scale of Cognitive Functioning."

The majority of the subjects in the patient groups received closed head injuries in automobile accidents. In the control group, 88.9% of the subjects were injured in such accidents. In the treatment group, 62.5% were similarly injured. The remainder of the subjects were injured by other means. These included anoxic encephalopathy and embolitic infarcts in the left frontal and limbic structures. These injuries resulted in cognitive and behavioral deficits similar to these seen in closed head and traumatic brain injuries.

Anoxic encephalopathy is a condition where generalized brain atrophy takes place. The damage is most frequently caused by a disruption of oxygenation to the brain tissue. This may be due to drowning, cardiac arrest or similar phenomena. This results in generalized cognitive and behavioral deficits. Embolitic infarcts take place when a small clot or fatty plaque lodges in a cerebral artery and blood flow to the surrounding tissue is disrupted. A localized area of damage follows and cognitive, motoric, or behavioral deficits will depend on the

function of the involved area. In the treatment group, 37.5% of the subjects were in this category. The control group had a total of 11.1% in the classification. The time since injury is closely related to this factor. The months post injury ranged from 7 to 35 months in the control group with a mean of 17.4 months and standard deviation of 9.7. The treatment group time since injury ranged from 4 to 28 months with a mean of 9.7 months and a standard deviation of 8.17.

Many of the patients participating in the study were involved in some form of rehabilitation program either in outpatient or inpatient programs. In several cases, the patients also participated in some form of cognitive retraining. Cognitive retraining therapy was provided by psychologists, speech therapists and occupational therapists. In no case did the patient's family members actively participate in the therapy. In the control group, 88.9% of the subjects had undergone rehabilitation treatment while 11.1% had not. In the treatment group, 87.5% participated in rehabilitation and the remaining 12.5% had no treatment. The control group had a total of 44.4% of the subjects who had undergone some form of cognitive retraining and 55.6% who had no experience with this therapy. In the treatment group, 37.5% of the subjects had exposure to cognitive retraining while 62.5% had not undergone treatment.

Brain injuries result in a variety of cognitive and behavioral impairments. These are frequently evaluated by observation. The "Rancho Los Amigos Scale of Cognitive Function" is used in many rehabilitation centers to evaluate cognitive and behavioral levels. The scale is easily learned and behaviors are clearly

defined. At level four of the Ranchos scale, the confused/agitated level, patients are generally confused and may become disruptive or combative in response to minor stimulation or environmental change. The study included patients between levels four and seven. At level seven, the automatic appropriate level, patients are able to carry out automatic behaviors such as dressing, eating and self care. They are socially appropriate in most settings but require supervision in novel situations. Ensley, MacLean, & Leward (1984) provide an excellent summary of the scale in their description of the cognitive evaluation and retraining program at Portsmouth General Hospital. In the control group, 44.4% were at level five, 33.3% were at level six, and 22.2% were at seven. In the treatment group, 12.5% of the subjects were at level four, 25.0% were at level five, 37.5% were at level six, and 25.0% were at level seven. Table 2 contains the means, standard deviations and percentages related to the patient injury variables.

Family member group

The family members of the brain damaged patients were the main focus of the experimental treatment. The subjects were members of the patient's immediate family and functioned as the patient's primary care-taker and supervisor. The identified family members also acted as the adjunct therapist in the treatment phase of the experiment. The groupings included the expected categories of mothers, fathers, children and siblings.

In the family member control group, the participants ages ranged from 21 to 52 years of age, with a mean age of 38.1 and a standard deviation of 9.8. The

TABLE 2

Patient Injury Variables

	Control Group: n=9		Treatment Group: n=8	
Continuous Variables	Mean	S.D.	Mean	S.D.
Months Post Injury	17.4	9.7	9.7	8.17

Categorical Variables

	% Group	% Group
--	---------	---------

Accident Type

Auto	88.9	62.5
Motorcycle	0.0	0.0
Employment	0.0	0.0
Other	11.1	37.5

Rehab Program Participation

Yes	88.9	87.5
No	11.1	12.5

Cognitive Retraining Program

Yes	44.4	37.5
No	55.6	62.5

Rancho Level of Cognitive Functioning

4	0.0	12.5
5	44.4	25.0
6	33.3	37.5
7	22.2	25.0

treatment group age range was from 16 years to 43 years, with a mean age of 30.6 years and a standard deviation of 8.9 years.

The majority of family members participating in the experiment were female. In the control group, 88.9% of the participants were female and 11.1% were male. The treatment group had a similar composition, with a total of 75.0% of the participants being female and 25.0% being male.

In the control group, 11.1% of the family members were divorced, 77.8% were married, and 11.1% were widowed. The treatment group contained 12.5% single participants, 75.0% married participants, and 12.5% widowed participants.

Family member educational status was represented by high school, technical school and college graduates. The control group contained 33.3% high school and 66.7% college graduates. The treatment family group contained 62.5% high school graduates, 12.5% technical school graduates, and 25.5% college graduates. No member of the family groups had completed graduate school of the "other" category used for elementary education levels. Table 3 contains the means, standard deviations and percentages for the family member group demographic variables.

Differences between groups

A major goal of the study was to insure the initial equality of the groups on demographic and injury related variables. This was essential for validity and generalization potential. All data was evaluated by the SPSS Cross-Tabulation analysis which yielded chi-square and Fisher's exact values for the nominal data.

TABLE 3

Demographic Variables: Family Members

Continuous Variables	Control Group (n=9)		Treatment Group (n=8)	
	Mean	S.D.	Mean	S.D.
Patient Age	38.1	9.8	30.6	8.9

Categorical Variables

Sex

Male

Female

Marital Status

Single

Divorced

Married

Widowed

Separated

Educational Level

High School

Tech School

College

Graduate

Other

% Group% Group

11.1

88.9

0.0

11.1

77.8

11.1

0.0

33.0

0.0

66.7

0.0

0.0

25.0

75.0

12.5

0.0

75.0

12.5

0.0

62.5

12.5

25.5

0.0

0.0

Continuous data was evaluated by way of one-way analysis of variance. Fisher's exact test values were generated when contingency tables were in a 2x2 format. Several of the demographic variables yielded 2x2 tables due to subjects falling into only two categories. Chi square analyses were utilized on all tables which were 3x2 or greater. Throughout the analyses, no significant differences were noted.

Patient groups

Age differences between groups were analyzed by one-way analysis of variance. The mean age differences between groups failed to show significance ($F = 0.53$, $df = 1/15$, $p > .05$). Table 4 contains the one way analysis of variance data on group age differences.

Patient group differences on demographic and injury related variables were analyzed by the use of chi-square analysis and Fisher's exact test results. Statistical analyses were completed on the following variables: sex, marital status, educational level, accident type, rehabilitation program participation, cognitive retraining program participation, and the Ranchos Los Amigos Level of Cognitive Functioning.

Table 5 contains the Fisher's exact test values, the chi-square values and the degrees of freedom for analysis for the demographic and injury variables for the patient control and treatment groups. Throughout the evaluation, no statistical differences between the control and treatment groups emerged.

TABLE 4

Anova Summary: Differences in Patient Age

Source	D.F.	S.S.	M.S.	F Ratio	Significance
Between Groups	1	95.00	95.00	0.53	$p > .05$
Within Groups	15	2670.76	178.05		
Total	16	2765.76			

Fisher's exact test produced a one-tailed value of 0.54 for differences between group sex. This was a non-significant difference. Accident type produced a value of 0.24, rehabilitation program participation, a value of .073, and cognitive retraining program participation produced a value of 0.58. All values were one-tailed analyses and none were found to be significant.

Chi-square analyses were completed on the variables of marital status, educational level and level of cognitive functioning. Between group differences on marital status were found to be non-significant with an obtained value of chi-square = 1.44, df = 2, p > .05. There were no significant differences between group educational levels, with an obtained chi-square value = 2.14, df = 4, p > .05. Finally, no differences were noted on the level of cognitive functioning between groups, chi-square = 1.61, df = 3, p > .05. All data for between group differences may be viewed in Table 5.

The final analysis of patient injury variables involved the differences between groups on the variable of time since injury. This was completed by one-way analysis of variance. The number of months since injury were utilized in the analysis. The mean differences between the control and treatment patient groups failed to show significant between group differences (F = 3.05, df = 1/15, p > .05). Table 6 contains the analysis of variance data on this variable.

Throughout the analysis, no significant differences were found between the patient control and treatment groups on the available variables. Given these findings, the groups were assumed to be equivalent.

TABLE 5

Demographic Variables: "Patients" - Between Group Differences

Variable	Chi-Square	D.F.	Fisher's Exact Test
			One - Tail
Sex			0.54*
Marital Status	1.44	2	
Educational Level	2.14	4	
Accident Type			0.24*
Rehab Program Participation			0.73*
Cognitive Retraining Program			0.58*
Rancho Level of Cognitive Functioning	1.61	3	

*Note: Original contingency tables with n per cell may be viewed in appendices D, I, J, and K.

TABLE 6

Anova Summary: Months Post Injury

Source	D.F.	S.S.	M.S.	F Ratio	Significance
Between Groups	1	250.74	250.74	3.05	$p > .05$
Within Groups	15	1229.72	81.98		
Total	16	1480.47			

Family member groups

Age differences between family member control and treatment groups were analyzed by one-way analysis of variance. Family members ages were used in the analysis and a level of significance of $p < .05$ was required to infer differences between groups. The mean differences between groups failed to show significant differences on the age factor ($F = 2.67$, $df = 1/15$, $p > .05$). Table 7 contains the analysis of variance data on group age differences.

Family member treatment and control group differences on demographic variables were analyzed by the use of chi-square analysis and by Fisher's exact test results values as reported in the "Patient Groups" subsection. Statistical analysis was completed on the variables of sex, marital status, and educational level of the control and treatment family member groups.

Fisher's exact test analysis produced a one-tailed value of 0.45 on the variable of family member sex. This was a non-significant difference and suggested that the groups were homogeneous on this variable. Chi-square analyses were completed on the variables of marital status and family member educational level. Between group differences on both variables were found to be non-significant. Marital status produced a chi-square value = 2.02, $df = 3$, $p > .05$. The educational level differences between groups was found to be non-significant with an obtained chi-square value = 3.45, $df = 2$, $p > .05$. Table 8 contains the Fisher's exact test values and chi-square values for the family member treatment and control group differences.

TABLE 7

Anova Summary: Family Member Age

Source	D.F.	S.S.	M.S.	F Ratio	Significance
Between Groups	1	237.35	237.35	2.67	$p > .05$
Within Groups	15	1332.76	88.85		
Total	16	1570.11			

TABLE 8

Demographic Variables: "Family Members" - Between Group Differences

Variable	Chi - Square	D.F.	Fisher's Exact Test
Sex			One - Tail 0.45*
Marital Status	2.02	3	
Educational Level	3.45	2	

*Note: Original contingency tables with n per cell may be viewed in appendix E.

Throughout the data analysis, no significant between group differences were obtained. Due to the lack of significant findings, the family member control and treatment groups were felt to be homogenous.

Data Analysis by Hypothesis

All dependent variable measures were analyzed by the use of a two-way analysis of variance with repeated measures on one factor. This analysis allows the evaluation of all pertinent factors related to the subject's groupings, the effect of time on the dependent variables, and finally the interaction effect, or differences which may emerge between groups across time. The interactive effect represents the treatment effect.

Hypothesis one

Family members participating in computerized cognitive retraining will report significantly greater levels of involvement than will family members who are in the treatment group.

It was hypothesized that the treatment group families would perceive their involvement in computerized cognitive retraining as problem solving behavior. Lowered scores on the inventory suggests improved problem solving skills. This is demonstrated by increased self-confidence, more efficient problem solving techniques, and a direct approach to the problem at hand. As problem solving skills improve, greater intrapersonal control is suggested.

Table 9 contains the pre and posttest results for the treatment and control groups on the "Problem Solving Inventory." Mean score change from the pre to

Problem Solving Inventory
Pre- and Post-Test Means and Standard Deviations

Group	Pre-Test	Post-Test
Treatment		
Mean	83.37	91.12
S.D.	22.25	27.08
Control		
Mean	98.11	104.00
S.D.	21.98	20.76

the posttest was minimal for both groups with the treatment group showing mean increase of 7.75 points and the control group showing a mean increase of 5.89 points.

Analysis of variance on all factors yielded no significant differences between the groups. On the grouping factor, the groups were found to be similar ($F = 1.91$, $df = 1/14$, $p > .05$). No differences between the groups across time were noted ($F = 2.14$, $df = 1/14$, $p > .05$). Finally, no significant interaction effect was noted on the group's perception of their problem solving abilities ($F = .01$, $df = 1/14$, $p > .05$).

The hypothesis regarding family involvement was not supported statistically. Table 10 contains the data related to the analysis of variance with repeated measures results on this variable.

Hypothesis two

- A. The family members participating in computerized cognitive retraining will report significantly less depression than will family members who are in the control group.

Levels of depression were evaluated by the use of the "Beck Depression Inventory - form D." Pretest scores for both the treatment and control groups fell within the moderate level of depression.

Table 11 contains the pre and posttest results for the obtained values on the "Beck Depression Inventory - form D." The treatment group showed a mean decrease from pre to posttest of 2.25 points while the control group demonstrated

TABLE 10

Summary: Analysis of Variance for PSI Total Scale

Across Treatment Conditions

Source	df	MS	F	Significance
Between S's				
Groups	1	1785.03	1.91	$p > .05$
Error-Between	14	930.63		
Within S's				
Time	1	413.28	2.15	$p > .05$
Interaction	1	2.53	.01	$p > .05$
Error-Within	14	191.62		

TABLE 11

Beck Depression Inventory - Form D
Pre- and Post-Test Means and Standard Deviations

Group	Pre-Test	Post-Test
Treatment		
Mean	12.75	10.50
S.D.	7.70	9.05
Control		
Mean	9.00	9.34
S.D.	8.11	10.71

only minimal change across the testing periods.

Table 12 contains the analysis of variance data for the control and treatment groups on the "Beck Depression Inventory - form D." No significant differences were noted between groups following treatment and the hypothesis was not supported.

Hypothesis two

B. The family members participating in computerized cognitive retraining will report significantly less hopelessness than will the family members who are in the control group.

Perception of hopelessness was measured by the use of the "Beck Depression Inventory - form H." High scores on the inventory are felt to suggest elevated feelings of interpersonal helplessness and hopelessness.

Table 13 contains the pre and posttest results for the two groups on the "Beck Depression Inventory - form H." Mean changes from pre to posttest were minimal for both the treatment and control groups.

Analysis of variance on all factors yielded no significant differences between the groups. On the grouping factor, the groups were found to be highly similar ($F = .01$, $df = 1/14$, $p > .05$). No significant differences were noted on the time factor ($F = 2.18$, $df = 1/14$, $p > .05$). Finally, no significant interaction effect (group x time), or the treatment effect, was noted on the group's perceived levels of hopelessness. Table 14 contains the analysis of variance data related to the dependent variable of hopelessness. This hypothesis was not supported by the

TABLE 12

Summary Table: Analysis of Variance for Levels of Depression

Across Treatment Conditions				
Source	df	ms	F	Significance
Between S's				
Groups	1	50.00	0.284	$p > .05$
Error-Between	14	176.035		
Within S's				
Time	1	18.00	2.666	$p > .05$
Interaction	1	4.50	0.667	$p > .05$
Error-Within	14	6.750		

Beck Depression Inventory - Form H
Pre- and Post-Test Means and Standard Deviations

Group		Pre-Test	Post-Test
Treatment			
	Mean	28.87	28.12
	S.D.	1.64	1.95
Control			
	Mean	28.77	28.44
	S.D.	3.03	

TABLE 14

Summary Table: Analysis of Variance for Levels of Hopelessness

Across Treatment Conditions

Source	dF	MS	F	Significance
Between S's				
Groups	1	0.125	0.0137	$p > .05$
Error-Between	14	9.125		
Within S's				
Time	1	3.125	2.108	$p > .05$
Interaction	1	.125	0.084	$p > .05$
Error-Within	14	1.48		

statistical analysis.

Hypothesis three

The family members who are involved in computerized cognitive retraining will experience and report significantly less anxiety than will family members who are in the control group.

Levels of anxiety were evaluated by the use of the Spielberger "State/Trait Anxiety Inventory." The state measure, the X-1 scale, is reported to be a measure of current levels of anxiety. This measure is reactive to the individuals current situation. The trait measure, the X-2 scale, is a more stable measure and is felt to reflect the subject's general level of anxiety. This measure is minimally reactive to the person by situation interaction.

The data reflected in Table 15 details the pre and posttest means and standard deviations for the control and treatment groups on the STAI-XI. The means for the control group showed a decrease of 1.67 from the pretest to posttest time. Conversely, the treatment group showed a mean increase across the treatment period of 2.50 points.

The analysis of variance with repeated measures on the state anxiety scores showed no significant differences between the treatment and control groups on either the grouping or the time factor (group: $F = .05$, $df = 1/14$, $p > .05$; time: $F = 0.11$, $df = 1/13$, $p > .05$). A significant difference was found on the interaction of group by time factor or the treatment effect. From the pretest to posttest period, the treatment group demonstrated a statistically significant

STAI - X_1 (State Anxiety)
Pre- and Post-Test Means and Standard Deviations

Group		Pre-Test	Post-Test
Treatment			
	Mean	43.62	46.12
	S.D.	5.92	5.11
Control			
	Mean	45.00	43.33
	S.D.	6.10	6.04

difference in the perceived level of state anxiety ($F = 5.73$, $df = 1/14$, $p < .05$). Cell means were then inspected. In the treatment group, state anxiety scores increased by 2.50 points following the experimental treatment. The control group scores decreased by 1.67 points, suggesting a mild decrease in state anxiety levels from pre to posttest. Table 16 contains the analysis of variance results from the STAI-X1 scores from the treatment and control groups.

Table 17 contains the pre and posttest results for the trait anxiety scale, STAI-X2, for the treatment and control groups. Mean score change was minimal from the pre to the posttest period for both groups.

The analysis of the test scores across all factors yielded no statistically significant differences between the groups. On the grouping factor, groups were found to be similar ($F = .15$, $df = 1/14$, $p > .05$). No significant differences on the STAI-X2 scores were noted across the time factor ($F = .15$, $df = 1/14$, $p > .05$).

Finally, no significant treatment effect, or the interaction between group and time, was noted ($F = .07$, $df = 1/14$, $p > .05$). Table 18 contains the result of the analysis of variance for this factor.

Hypothesis four

Family members who are participating in computerized cognitive retraining programs with the brain injured patients will report significantly fewer family problems than will family members who are in the control group.

The dependent variable, perception of family problems was evaluated by

TABLE 16

Summary Table: Analysis of Variance for Levels of State-Anxiety

Across Treatment Conditions

Source	dF	MS	F	Significance
Between S's				
Groups	1	3.781	0.057	$p > .05$
Error-Between	14	65.977		
Within S's				
Time	1	0.781	0.117	$p > .05$
Interaction	1	38.281	5.735	$p < .05$
Error-Within	14	6.674		

TABLE 17

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STAI - X_2 (Trait Anxiety)

Pre- and Post-Test Means and Standard Deviations

Group	Pre-Test	Post-Test
Treatment		
Mean	45.12	46.00
S.D.	6.91	9.53
Control		
Mean	47.33	6.10
S.D.	46.66	4.92

TABLE 18

Summary Table: Analysis of Variance for Levels of Trait-Anxiety

Across Treatment Conditions

Source	df	MS	<u>F</u>	Significance
Between S's				
Groups	1	15.125	0.158	$p > .05$
Error-Between	14	95.703		
Within S's				
Time	1	0.125	0.152	$p > .05$
Interaction	1	8.000	0.975	$p > .05$
Error-Within	14	8.205		

the use of the "Scale of Marriage Problems." Higher scores on the scale suggest increasing levels of both number and severity of problems.

Table 19 contains the pre and posttest results for the control and experimental groups on the "Scale of Marriage Problems." Both groups demonstrated mild decreases in test means across the treatment period. The control group mean decreased by 0.78 points while the treatment group decreased by 2.25 points.

The data analysis on all factors of the dependent variable yielded no significant differences between the groups. On the grouping factor, the groups were found to be similar across measures ($F = .41$, $df = 1/14$, $p > .05$). Further, no significant differences between the treatment and control groups were noted across the time factor ($F = 1.93$, $df = 1/14$, $p > .05$). Finally there was no significant difference between the groups on the treatment factor ($F = .37$, $df = 1/14$, $p > .05$). Given these results, the treatment appeared to have minimal impact on the family's perception of number and severity of general problems and the final hypothesis was not supported by the research findings. Table 20 contains the results of the analysis of variance with repeated measures on the dependent variable.

Scale of Marriage Problems
Pre- and Post-Test Means and Standard Deviations

Group		Pre-Test	Post-Test
Treatment			
	Mean	64.12	61.87
	S.D.	19.05	16.65
Control			
	Mean	58.00	57.22
	S.D.	11.50	10.81

TABLE 20

Summary Table: Analysis of Variance for SMP-Total Scale

Across Treatment Conditions

Source	dF	MS	<u>F</u>	Significance
Between S's				
Groups	1	185.28	.41	$p > .05$
Error-Between	14	448.99		
Within S's				
Time	1	19.53	1.93	$p > .05$
Interaction	1	3.78	.37	$p > .05$
Error-Within	14	10.08		

IV. DISCUSSION

The results of this study do not support the effectiveness of computerized cognitive retraining as a specific intervention modality for the families of brain damaged individuals. No statistically significant differences were found between the treatment and control groups on measures of perception of family involvement, depression, hopelessness, trait anxiety, or on measures of problem solving confidence and ability. The treatment group did demonstrate a statistically significant increase in state anxiety following the experimental treatment. This difference was not in the hypothesized direction and was contrary to the symptom reduction proposed by all hypotheses.

The experimental treatment did not produce the hypothesized positive change on the dependent variables of family involvement, depression, hopelessness, trait anxiety, or perception of problem solving and problem solving ability. Minor changes were noted on these variables, but these changes were non-significant.

Family involvement in the experimental treatment was evaluated by use of a problem solving inventory. Both the control and experimental groups had minor changes on these measures, suggesting some deterioration across the treatment period. The between group differences were not statistically significant.

Both groups had some change on measures of depression and the

secondary measure of hopelessness. Minimal change was noted on the hopelessness scale. On the depression scale, a minor decrease in depression was noted in the treatment group, but this was non-significant.

There was little change noted in both group's level of trait anxiety. This is consistent with the suggestions that trait anxiety is a steady state which is not reactive to external events for the situation by person interaction. There were no significant changes on the families' perception of problems or problem solving ability during the treatment period. The lack of significant findings on these measures requires consideration.

The treatment literature associated with brain injured populations suggests that all of these areas are significant concerns to the families of persons experiencing brain injuries. Prior to the initiation of this study, the researcher observed what appeared to be affective and cognitive changes in the families as they worked with the cognitive retraining techniques. The results of this experiment do not support this position. This may be due to a variety of factors. These include:

1. The present experiment utilized a small number of subjects and group differences would have to be large to produce significant results in such a small population.
2. The treatment was much shorter than is usually experienced by families undergoing computerized cognitive retraining.
3. The small number of subjects and the shortened treatment may have

interacted to produce minimal effects on the involved subjects.

4. The treatment was standardized for the purpose of experimental control. This may have minimized its effectiveness with difficult patient groups.

5. The experiment contained patients at differing cognitive levels. Computerized cognitive retraining programs are tailored to the specific functional level of the patient. As a result of this control measure, the treatment effects, both positive and negative, were not obvious to the families while they worked with the patients.

These effects may have minimized the impact of the treatment and, as a result, did not produce the desired level of information on cognitive processing and behavioral response to the family members. These factors, singularly or in combination, may have interfered with the treatment effect in this experiment.

The significant increase in state anxiety in the treatment group was a finding which was not expected or predicted. This finding leads to several clinically challenging questions.

Iatrogenic effects

Iatrogenic effects are those symptoms or syndromes which are potentiated or accentuated by inadvertent effects in psychological or medical interventions. There is an increasing awareness of these effects in the treatment literature, but specific syndromes are not clearly presented. Further, the use of computerized cognitive retraining is a relatively new intervention and such effects may not have surfaced in the literature specifically dealing with this area.

The only report of an inferred iatrogenic effect was by Wong, Campbell, and Baker (1983). They reported that a severely brain injured patient experienced grand mal seizures after playing video games for an extended period. The patient had had seizure medications discontinued while hospitalized. There was no history of previous seizure activity. A visually evoked seizure was a possible explanation. Brain injury patients have a higher risk of seizures due to the nature of their injuries. It was not clearly documented that the activity was directly related to the video games.

While a negative iatrogenic effect cannot be ruled out by the findings of this study, the behavior of the families seems to contradict negative implications. In both the control and treatment groups, participation in individual and family treatment increased immediately following the experimental period. It is significant to note that treatment requests from the control group increased following the computerized cognitive retraining sessions that were offered after the posttesting. This group had even less exposure and involvement in the treatment than the experimental group.

Treatment Expectations of the Family

The expectation of positive treatment results may have had a significant influence on the outcome of the experiment. Families of brain damaged patients frequently have unrealistic expectations for major changes in the patient's mental status. Hope is high and reality testing may be limited by the emotional impact of the patient's injuries and disabilities. The families may have developed

expectations for a rapid recovery of cognitive and behavioral functions as a result of computerized retraining. While such expectations are unrealistic, families in similar situations may hope for a miracle cure or treatment. This is frequently seen in families of cancer victims.

The brief treatment protocol did not result in significant cognitive or behavioral gains with the majority of the patients. If substantial gains were expected, the experience would be negatively reinforcing for the families due to their unrealistic expectations for rapid recovery. Further families may view full recovery as the only successful treatment. Such recovery is rarely documented after a moderate to severe brain injury. These factors may have reinforced the belief that there is little which could be done for the patient's thinking and behavior.

If the families of the treatment group had high expectations for the patient's progress with the computerized cognitive retraining, they received little reinforcement. The patients made few cognitive gains and demonstrated little behavioral change during the experimental treatment. The cognitive and behavioral gains which have been observed and reported in the literature have taken place over periods of up to twenty-four months. If the involved families expected significant gains, the lack of major change in cognition or behavior may have functioned as a stressor. Behaviorally, increased intrapersonal tension would result. This could account for the significant increase in state anxiety which was observed in the treatment group.

In an anecdotal review of treatment records and referrals, it was noted that both the treatment and control groups actively sought increased treatment for the family members involved with the brain injured patients. In the treatment group, 75% of the group became involved in individual counseling, family counseling, or in a family support group. The response of the control group was similar, with 66% of the family participants seeking treatment. If the observed effect was a negative effect, one would expect withdrawal from therapy rather than increased requests for services. Further, the families have persisted in therapy or the support group.

The families reported similar response to the cognitive retraining program. Of the original treatment sample, approximately 62% of the group have continued with the cognitive retraining program and are active participants with the identified patients. One patient transferred to another rehabilitation program, but the family requested that cognitive retraining be a component of the process. There was one patient and family who requested that treatment be discontinued. One patient was discontinued due to a lack of funding. In this situation, the patient and family desired the treatment and are seeking a funding source for the continuation of cognitive therapy. Response to treatment was similar in the control group.

Since the completion of the experiment, 55% of the control group have become involved in computerized cognitive retraining. Remaining group members have transferred to inpatient rehabilitation programs for further

services. This group stated that the presence of computerized cognitive retraining programs influenced their selection.

The increase in treatment seeking from both the brain injured patients and their families suggests that they viewed the experimental treatment as beneficial rather than aversive. The increase in anxiety may serve a therapeutic function. This apparently encouraged the target population to engage in more productive symptom reducing behaviors.

Family System Response

Family systems theory may provide insight to the unexpected findings of this experiment. Generally stated, systems theory suggests that the family is an active and reactive emotional system when major problems or difficulties develop, problem solving becomes an active dynamic within the system. When one member of the system becomes dysfunctional, for whatever reason, the remainder of the system attempts to compensate behaviorally. These behaviors may be effective or problematic, depending on the family's sophistication and prior experiences with problem solving. Whether effective or ineffective, the family system attempts to move toward a steady behavioral state, or homeostasis by compensatory behaviors. Behavioral change within the system is a key assumption of the theory. It is assumed that if one element of the system changes, there will be compensatory changes in the remaining elements of the system.

Within the system, stressors serve a vital function. While the steady state is

the desired level within the family, stress may serve to initiate a morphogenic process in which the family reacts to a deviant, ineffective or undesirable state. Stress is the precursor to the initiation of positive change. The initiation of a stress inducing state may then be therapeutic and encourage the family system to actively deal with the problems at hand (Freeman, 1981).

The families of brain damaged patients may stabilize, or achieve a homeostatic state, to deal with the problems of living with and caring for their family member. While this may be an effective short term coping mechanism, the literature suggests that problems increase with time.

Psychosocial Adaption to Traumatic Brain Injury

A variety of studies report that individual dysfunction increases over time in brain injured patients. This is seen both in both moderate and severe injuries. This change will effect the family as well as the patient.

Levin (1985) reported that behavioral disruption increases and reactive depression is seen as patients attempt to reintegrate themselves into familial and work roles. Symptomology is proportional to the difficulties encountered. Ruff (1985) reported similar findings. He noted that virtually all moderate to severe brain injury patients have increased subjective complaints of psychological problems as a result of compensated coping and social skills. Thomsen (1974) reported that the most common complaint of brain injured patients was increased isolation and loneliness. Oddey, Humphrey, and Uttley (1978) also reported that brain injured population are significantly more isolated, have less close friends,

and have fewer outings and social contacts than do mildly injured or non-injured populations. These effects appear to be due to the emotional problems accompanying a brain injury. This would seem to increase the patient's dependence on the family and result in adaptive difficulties for the system.

Family Coping

Increased adaptive difficulties for the families of brain injured individuals are well documented. McKinlay et al. (1981) reported that the level of stress in families of brain injured patients was directly related to the severity of residual psychological symptoms. As the level of stress increased, the subjective complaints of the family increased. In a 1983 study, Fordyce, Roueche, and Prigatano reported that "cohabiting" relatives viewed problems and symptoms as increasing over time rather than decreasing or stabilizing. Finally, Livingston, Brooks, and Bond (1985) reported that familial anxiety is the most pervasive symptom when a brain injured individual is present. These symptoms increase for approximately one year then apparently stabilize in an uncomfortable steady state where denial and repression help maintain the function of the family system.

Many families of brain damaged individuals have difficulty dealing with the psychosocial implications of the injuries. An illness or injury produces a great deal of tension within the family system. Under the best circumstances, adaptive capabilities are strained. Families with good coping skills and adequate resources report difficulties dealing with such situations. These difficulties are intensified with a brain injury. This seems to be due to the chronic nature and

severity of the resulting disabilities.

Research suggests that some families who experience a traumatic brain injury within the system had adaptive difficulties prior to the patient's injury. McLaughlin & Schaffer (1983) reported that the premorbid incidence of drug and alcohol problems, marital dysfunction, and social problems was higher in their brain-injury populations than in similar populations. These findings were consistent with the earlier reports of Jennette (1972) and Jamieson (1971). Both studies noted a high pre-injury incidence of poor coping skills and adjustment difficulties in families where brain injuries had taken place. While retrospective accounts may overemphasize the past problems of such families in an attempt to explain subsequent familial problems, these reports merit consideration. If adaptive difficulties and poor coping skills were present premorbidly, it would make dealing with the increased stress of a traumatic brain injury more difficult.

These results suggest that attempts to cope with the stress of a brain injury are difficult due to individual and family problems that may co-exist. Further, there is reason to believe that these effects may increase over time rather than decrease or stabilize. Denial appears to be the key defense the family uses to move toward a homeostatic state. If marginally achieved, this is fragile and may be the point where intervention becomes most feasible.

Implications for Family Involvement in Computerized Cognitive Retraining

The results of this experiment do not support the use of computerized cognitive retraining as a specific intervention modality for the families of patients

experiencing a traumatic brain injury. The families participating in the experiment showed minor, and statistically insignificant changes on measures of problem solving, affective stability and measures of involvement in the treatment process. Computerized cognitive retraining is a recent development in the long term care of the neurally injured patient and family involvement seems to expedite the therapy, but this hypothesis was not tested. Specific benefits to the family system were not supported by the results of this experiment.

Family intervention is well documented in the literature of chronic and disabling disorders. Further, several authors in the rehabilitation literature strongly suggest that familial treatment is essential to the rehabilitation process.

Deaton and Rouche (1985) suggested the use of interactive groups and vidoetaped role playing as a method for dealing with the denial which may be seen in brain damaged patients and their families. Sena (1985) stressed the need for concurrent treatment of the family members while the identified patients underwent cognitive retraining programs. He noted that families needed the support and information provided by educational, individual, family and group therapies.

Similarly, Bracy (1985) reported that families receive little counseling or training for dealing with the disabilities which accompany a neurological injury. Bracy reports that family stabilization and treatment is essential to the successful rehabilitation of the injured patient, but he does not address specific methodology. Weakland (1980) suggested that family therapy is essential when

any illness or injury disrupts the function of the family system. He specifically suggested that therapy should focus on the family's understanding of the pathology and its potential outcomes as well as concrete problems which accompany the process.

The most direct psychoeducational approach was suggested by DeBoskey and Morin (1985). They suggested the use of an educational manual and group education sessions for the patient and their family. The manual presents specific behavioral examples and interventions which may be used by the family. Further, it outlines familial responses and interventions which may be used for dealing with a variety of maladaptive responses.

The implications for intervention with the families of brain injured individuals seems clear but several questions remain unanswered. While a variety of authors suggest the use of familial interventions, there is little supportive research for specific methodology. This area requires a great deal of research and development so effective treatment modalities can be identified.

Suggestion for Further Research

As has been noted, much of the literature in this area strongly suggests the use of family intervention in conjunction with the individual treatment of the brain injured patient. It is reported that this is an essential component of comprehensive rehabilitation treatment but there are few specific treatment modes suggested. Of the modalities presented there are no studies suggesting the effectiveness of the interventions. The majority of the outcome studies note

the progression of the patient or describe familial problems over time.

Depression, anxiety, and family adaptive problems are widely reported. The results of this experiment seem to support these findings in the target population associated with the Patricia A. Neal Rehabilitation Center in Knoxville, Tennessee. While the experimental treatment had no effect in improving these problems, it was noted that a brief treatment period and non-specific cognitive retraining increased the state anxiety level in the target population, but not in the control group. These results strongly suggest the need for continued research in the area of family response to computerized cognitive retraining.

The results of this experiment should be replicated to note if the observed effects were due to the treatment as is suggested or to some extraneous factor which has yet to be identified. Further research should include a larger number of subjects so that any statistical effects which are present may be more clearly observed. The limited number of subjects in the current experiment may have served to suppress significant findings. Similarly, other areas require increased control before the results may be safely generalized.

Treatment in this experiment consisted of a pre-defined series of retraining programs which were not designed to meet the specific cognitive levels of the patients involved. Future research should have a brief training period for the family with a similar group of programs and then progress to routines which are specific to the patient's needs and cognitive level. It would also be useful to increase the treatment time. Computerized cognitive retraining is a long term

therapy and gains may not be noted for weeks or months. Clearer effects may be seen if the families receive more accurate feedback, via the computer, on the patient's specific cognitive deficits and his or her emotional responses to these. Such an approach would require that treatment effects be evident in the patient group.

There is a need for research on the effectiveness of interventions which are utilized with the patients and their families. Individual counseling, group counseling, family therapy, and psychoeducational counseling are widely suggested, but the effectiveness of these treatments is unclear. It is possible that single or combined therapies may be extremely effective, but this is not documented. It is also necessary to see if computerized cognitive retraining interacts with other therapies. Such research is difficult to design and control, but would provide invaluable information to the clinicians working with such patients and families.

Patients at differing cognitive levels may generate family responses which vary according to the patient's functional status. It may be assumed that more severely impaired individuals require greater familial intervention and subsequently are a greater stressor on the family system. Future research should control for mild, moderate, and severe injuries which have varying levels of cognitive and physical involvement.

Research should look at external factors which may influence the family's adaptive abilities. It has been suggested that a history of family problems may be

significant in many head injury families. Alcohol, drugs, multiple social problems, family breakdown and dysfunction are documented and must be controlled. Further, the possibility of pre-existing mild head injury may effect the outcomes of such research. These factors require control before the outcomes may be generalized to other similar populations.

Finally, such research requires the use of more sophisticated instrumentation and multiple methods of measurement. The instruments utilized in this experiment were adequate for the task at hand, but are not as sensitive and as specific as might be desired. Evaluation and treatment should be isolated to single emotional or adaptive factors and these variables fully evaluated. McCready, Berry, and Kenkel (1985) suggest that measurement and treatment of anxiety requires both affective and physiological measurement. A similarly specific approach to cognitive, affective and adaptive parameters would increase the usefulness and specificity of any outcome findings.

As Levin (1985) reports, the increase in rehabilitation treatment necessitates the investigation of the most effective methods for the retraining of the involved patients. Researchers must find the most effective methods for minimizing and controlling the negative familial effects of living with and caring for a brain injured individual.

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APPENDIX A
STATEMENT OF INFORMED CONSENT

STATEMENT OF INFORMED CONSENT

Computerized cognitive retraining is a well established technique for the remediation of cognitive and behavioral changes which may follow a traumatic brain injury. The technique utilizes specifically developed computer software which builds on the foundations of intellectual functioning. While the injured patient is the primary target of this intervention, the method also appears to have an impact on the patient's family as well. The goal of this study is to evaluate the effect of familial participation in computerized cognitive retraining.

Prior research suggests that computerized cognitive retraining is a well established and effective therapeutic method. Research also suggests that there are only minimal risks involved in this treatment. The risks are no greater than the risks encountered in other methods of psychotherapy and cognitive retraining.

I, _____ hereby agree to voluntarily participate in a research study being conducted by Thomas M. Pendergrass, a doctoral student at Ball State University, Muncie Indiana. The study is entitled: FAMILY RESPONSE TO COMPUTERIZED COGNITIVE RETRAINING WITH BRAIN INJURED INDIVIDUALS.

My involvement in the study is limited to the following:

1. Participation in five , one hour sessions of computerized cognitive retraining with my injured family member.
2. Completion of the following tests/questionnaires twice during the course of the study: Beck Depression Inventory, State-Trait Anxiety Inventory, Scale of Marriage Problems, Problem Solving Inventory, and a demographic questionnaire.
3. I understand that my participation is completely voluntary and I may terminate at any time without prejudice.
4. All research information will be maintained in secure fashion and my anonymity will be completely protected. All responses and answer sheets will be numerically coded and will be destroyed ninety days after publication of the results of the study. All research records will be kept in locked files in the office of the principal investigator.
5. All information about me obtained during the course of the study will be strictly confidential. Information may be released only by written consent. This will include only the data I specify which may be released to the professional and/or organization which I identify and request.
6. I understand that a copy of this form will be provided to me for my records. I do not have to answer any questions if I choose not to.

I understand that by making a request within ninety days of the

publication of the study, I may receive both the individual results of my own scores and the results and conclusions of the study when they are published. If I have any questions about the study, they will be directly and honestly answered by the principal investigator. I may contact the investigator at:

Thomas M. Pendergrass
Psychology Department
Fort Sanders Regional Medical Center
Knoxville, TN.
971-1246

I have read the above statements and agree to participate in this study.

DATE_____

PARTICIPANT_____

PARTICIPANT_____

INVESTIGATOR_____

APPENDIX B
RESEARCH PROJECT INFORMATION

RESEARCH PROJECT INFORMATION

I would like to take this opportunity to invite you to participate in a study of patients who have experienced a brain injury and their families. Neuropsychologists have developed a variety of techniques to aid both the victims and their families in dealing with the behavioral, memory and learning problems which frequently follow such injuries. This study, entitled, "Family Response to Computerized Cognitive Retraining with Brain Injured Individuals" will utilize computerized cognitive retraining, involving both the injured individual and a primary family member.

Computerized cognitive retraining is a well established technique for the remediation of cognitive and behavioral changes which follow a traumatic brain injury. The technique utilizes specifically developed software which builds on the foundations of intellectual functioning. While the injured patient is the primary target of this intervention, the method also appears to have a significant impact on the patient's family as well. The goal of the study is to evaluate the effect of familial participation in computerized cognitive retraining.

Prior research suggests that computerized cognitive retraining is a well established and effective therapeutic method. Research also suggests that there is little, if any, risk involved to

those utilizing this method of treatment. Participation in the study will be limited to five, one hour sessions of computerized cognitive retraining. Participants will also be asked to fill out several tests and questionnaires during the course of the study. The specified cognitive retraining sessions will be provided free of charge to the patients and families interested in participating in this study.

If you find any of the things you learn to be of use in working with your family member, you will be provided with information on where you can continue similar methods.

If you, or anyone you know, is interested in participating in this project, please contact:

THOMAS M. PENDERGRASS
PSYCHOLOGY DEPARTMENT, PATRICIA NEAL REHABILITATION CENTER
FORT SANDERS REGIONAL MEDICAL CENTER
KNOXVILLE, TN.
PHONE: 971-1246

Thank you for your consideration.

Sincerely,

Thomas M. Pendergrass
Thomas M. Pendergrass
Doctoral candidate
Ball State University
Muncie, Indiana

APPENDIX C
RESEARCH INFORMATION FORM

RESEARCH INFORMATION FORM

PATIENT NAME: _____ STUDY NUMBER _____

ADDRESS: _____

HUSBAND/WIFE/PARENT NAME: _____

PATIENT AGE: _____ HUSBAND/WIFE/PARENT AGE: _____

MARITAL STATUS (PATIENT): SINGLE DIVORCED MARRIED WIDOWED
SEPARATED

MARITAL STATUS (FAMILY MEMBER): SINGLE DIVORCED MARRIED
WIDOWED SEPARATED

PATIENT EDUCATIONAL LEVEL: HIGH SCHOOL TECHNICAL SCHOOL COLLEGE
GRADUATE SCHOOL

FAMILY MEMBER EDUCATIONAL LEVEL: HIGH SCHOOL TECHNICAL SCHOOL
COLLEGE GRADUATE SCHOOL

TYPE AND DATE OF ACCIDENT:

AUTO ACCIDENT DATE: ___/___/___

MOTORCYCLE ACCIDENT DATE: ___/___/___

ACCIDENT/EMPLOYMENT RELATED DATE: ___/___/___

OTHER ACCIDENT: TYPE _____ DATE: ___/___/___

PARTICIPATION IN REHABILITATION PROGRAM YES NO

IF YES, WHERE _____

DATE: ___/___/___

PARTICIPATION IN COGNITIVE RETRAINING PROGRAM YES NO

IF YES, WHERE AND BRIEF DETAIL OF PROGRAM: _____

LEVEL OF FUNCTION (RANCHOS LOS AMIGOS SCALE): 1 2 3 4 5 6 7

APPENDIX D

CONTINGENCY TABLE: PATIENT SEX